African Cities and the Structural Transformation: Evidence from Ghana and Ivory Coast

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Abstract

Africa has recently known dramatic urban growth, which is good news if urbanization drives growth. Yet, the agglomeration effects story was built on manufacturing and tradable services, two sectors under-represented in Africa. We develop another story where urbanization is pushed by rural windfalls, with a case study on cocoa production and cities in Ivory Coast and Ghana. Combining decadal district-level data on cocoa production and cities from 1901 to 2000, we show how cities follow the cocoa front. Indeed, we use the fact that cocoa is produced by "eating" the virgin forest: (a) only forested areas are suitable to cocoa, i.e. the south of both countries, (b) for agronomic reasons, cocoa farmers move to a new forest every 25 years, thus causing regional cycles, and (c) the cocoa front has started from the (South-)East of both countries. The cocoa front had to move westward, within the South. We can instrument cocoa production with a westward wave. We find that cocoa production explains more than half of urbanization in both countries. We give evidence for the channels underlying this relationship, emphasizing consumption linkages that create consumption cities. We discuss whether such a specialization can make African cities powerful engines of growth.

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"I had a marvellous dream [...]. Close to a castle, I have seen a man all dressed in white who told me: several years ago, this region was covered with forests. It was only missing hands to work. Compassionately, some men have come. [...] The forest has been gradually disappearing in front of labourers, tractors have replaced the daba [hoe] and beautiful cities, beautiful villages, beautiful roads have replaced the tracks only practicable during the dry season."

Houphouët-Boigny's Presidential Address, 25 March 1974.

"Africa's long-term growth also will increasingly reflect interrelated social and demographic trends that are creating new engines of domestic growth. Chief among these are urbanization and the rise of the middle-class African consumer. [...] In many African countries, urbanization is boosting productivity (which rises as workers move from agricultural work into urban jobs), demand and investment."

Lions on the Move: The Progress and Potential of African Economies, McKinsey 2010.

1 Introduction

While Sub-Saharan Africa was unurbanized at the turn of the 20th century, it has recently known dramatic urban growth and it has now a larger urban population than Northern America or Western Europe (Satterthwaite 2007, WDR 2009).[1] Surprisingly, African countries are on average more urbanized than India and almost as urbanized as China. The urbanization rate is estimated at 30.0% in India, 37.2% in Sub-Saharan Africa, and 47.0% in China in 2010 (WUP 2009). It is respectively 51.5% and 50.6% for Ghana and Ivory Coast, the two countries we study in this paper.[2] Taking Sub-Saharan Africa as a whole, it has also less megacities than China, but more than India.[3] If Africa is certainly lagging in terms of economic growth, it is not lagging in terms of urbanization. This is all

[1] The urbanization rate of Sub-Saharan Africa is estimated at 5% around 1900 (Bairoch 1988), 11% in 1950 and 37.2% in 2010 (WUP 2009). Post-1950 Africa has thus experienced amongst the highest rates of urban change ever registered in the history of mankind (Satterwhaite 2007).

[2] These results are subject to national differences in the definition of urbanization. Defining as urban all the localities with more than 5000 inhabitants, we estimate the following urbanization rates using census data: 27.7% in India (2001), 43.8% in Ghana (2000) and 55.2% in Ivory Coast (1998). Unfortunately, the Chinese 2000 Population Census does not directly report the population in towns with more than 5000 inhabitants.

[3] Sattherwaite (2007) reports that Africa has 37 "million" cities in 2000, while China has 86 and India 32. Africa has 8 of the world's largest 100 cities, while China has 17 and India 8. But Africa has 25 of the world's fastest-growing large cities, against 15 in China and 8 in India.

the more puzzling if development is highly correlated with urbanization, as shown in Acemoglu, Johnson and Robinson (2002) and Henderson (2010).

Development is indeed associated to the structural transformation, the economic transition from rural-based agriculture to city-based manufacturing and services (Caselli and Coleman II 2001, Gollin, Parente and Rogerson 2002, Michaels, Rauch and Redding 2010). This is the path borrowed by developed nations more than one century ago (Bairoch 1988, Williamson 1990, Kim 2007, WDR 2009). This is the path explored by China and India today (Satterwhaite 2007, Bosworth and Collins 2008, Deng et al. 2008). Comparing all those countries, manufacturing and tradable services have always been at the heart of their urbanization process. Yet, those two sectors are "missing" in Africa and primary exports seem to be the main drivers of urbanization there. Figure 1 plots the urbanization rate and the GDP share from manufacturing and services for developing countries in 2000. We find a strong and positive correlation in America and Asia, but no correlation in Africa. Figure 2 plots the urbanization rate and the GDP share from the export of primary commodities in Africa, whether mineral products or cash crops. We use the GDP share in 2000 (subfigure a.) and the average GDP share between 1960 and 2000 (subfigure b.), which is less sensitive to recent oil discoveries. In both cases, we observe a positive relationship between urbanization and primary exports. Lastly, figure 3 maps cities, regional cash crop production and main oil/mining producing areas in 2000 for West African countries.[4] Excluding "princely cities" such as national and regional capitals, there appears a strong spatial correlation between urbanization and proximity to cash crops and mineral resources.[5] African cities are thus intimately linked to cash crop, oil and mining windfalls, whether as producing, trade or administrative centers.

We document this specific urbanization process in Africa with a case study on the role of cocoa production on cities in Ivory Coast and Ghana, two leaders of the African "cash crop revolution" (Tosh 1980, Austin 2008). Cocoa has been the main motor of their economic development (Teal 2002, Cogneau and Mesplé-Somps 2002, Austin 2007). Production boomed after the 1920s in Ghana and the 1960s in Ivory Coast (see figure 4). In Ivory Coast, the cocoa boom was accompanied by a coffee boom, as cocoa farmers also produce coffee. We thus consider cocoa and coffee altogether in that country.[6] Then, while both countries were unurbanized at

[4]We define as urban all the localities with more than 5000 inhabitants. This rather arbitrary definition is consistent with previous comparative studies of urbanization (Bairoch 1988).

[5]Except for Nigeria, there were very few cities one century ago. Therefore, cities in 2000 almost represent the change in urbanization since 1900.

[6]Between 1948 and 2000, cocoa and coffee have accounted for 60.2% of exports and 20.6% of

the turn of the 20th century, their respective urbanization rate (using the localities with more than 5000 inhabitants) is 43.8% and 55.2% around 2000, making them two of the most urbanized countries in Africa.[7] As figure 5 shows, the total and urban populations of both countries have dramatically increased after World War II. Figure 6 displays the urbanization rate of both countries and their primacy rate, which we calculate as the size of the largest city (Accra for Ghana, Abidjan for Ivory Coast) over total population. Ghana started its urban transition earlier than Ivory Coast, but both experienced spectacular urbanization after 1948. Then, most of post-1948 urbanization was driven by more secondary cities.

We combine decadal district-level data on cocoa production and cities from 1901 to 2000, and we document how cities follow the cocoa front. Our identification strategy uses the fact that cocoa is produced by "eating" the virgin forest: (a) only forested areas are suitable to cocoa, i.e. the south of both countries, (b) for agronomic reasons, cocoa farmers move to a new forest every 25 years, thus causing regional cycles, and (c) the cocoa front has started from the (South-)East of both countries. This forced the cocoa front to move westward, within the South. We can instrument cocoa production with a westward wave. Our results suggest that local cocoa production has a large impact on local urbanization, whether one considers new cities or already existing cities growing further. In total, we find that cocoa production explains more than half of urbanization in both countries. Second, we give evidence for the various channels behind this relationship. We find that cash crop production has mostly consumption linkages, which causes the rise of "consumption" cities consisting of farmers, traders and employees of the personal services industry. As cities keep growing in old cocoa-producing districts, we also document the long-term impact of better infrastructure and natural demographic growth. Third, we discuss whether those cities could be powerful engines of growth. Limited evidence indicates that cities in old cocoa-producing regions do not exhibit any structural transformation, as they have less manufacturing and are less economically diversified. To conclude, in the African context, primary exports can drive urbanization through consumption linkages, but they do not give rise to "production" cities based on manufacturing or tradable services. Thus, the structural transformation is very unusual in Africa.

GDP in Ivory Coast, and cocoa has amounted to 56.9% of exports and 12.1% of GDP in Ghana.

[7] Ghana had nine cities of more than 5000 inhabitants in 1901 and its two largest cities were Cape Coast (28,948 inhabitants) and Accra (14,842). Ivory Coast did not have any such city, and Abidjan was then a small fishing village with less than 1000 inhabitants. The population of Accra and Abidjan were respectively estimated at 2,527,014 in 2000 and 2,955,578 in 1998.

In addition to the literature on the structural transformation, this paper is related to a large body of work on the relationship between urbanization and growth. It can be argued that cities improve efficiency and promote growth in developing countries (Duranton 2008, Venables 2010). Those works are based on previous studies showing there are agglomeration economies, both within sectors (*localization economies*) and across sectors (*urbanization economies*), in both developed countries (Rosenthal and Strange 2004, Henderson 2005, Combes, Duranton, Gobillon and Roux 2011) and developing countries (see Overman and Venables 2005, Henderson 2010 and Venables 2010 for references). This potential role of cities as engines of African growth has been lately highlighted by public policy publications (WDR 2009, McKinsey 2010). Yet, an optimistic view of urbanization in developing countries could be contradicted by empirical evidence on Africa. "Explosive urbanization", "overurbanization" or "urbanization without growth" are expressions frequently read in the literature on African cities (Bairoch 1988, Fay and Opal 2000). They imply that Africa has urbanized without it being fully explained by economic development, unlike developed countries. This excessive urbanization is attributed to pull and push factors feeding rural exodus. First, cities are associated to a parasital public sector, that feeds itself on the taxation of rural farmers (Bates 1981, Bairoch 1988). An extreme version of the urban bias story is primacy, when the largest city is oversized compared to the rest of the urban population (Davis and Henderson 2003). Henderson (2003) and Duranton (2008) show that primacy is detrimental to growth. Second, land scarcity and rural shocks can encourage rural exodus (Becker and Morrison 1988, Barrios, Bertinelli and Strobl 2006, Poelhekke 2011). Lastly, the "classical" structural transformation is based on manufacturing and tradable services, two sectors with large returns-to-scale, strong backward and forward production linkages, and directly benefiting from localization and urbanization economies (Glaeser and Gottlieb 2009). But the African structural transformation is driven by primary exports, which may display smaller agglomeration economies (Fafchamps 2003). African cities are mostly consumption cities based on agriculture, non-tradable services and trade. Whether such sectors can be sources of sustained growth is difficult to say, given the lack of related research. Yet, there has been a long debate regarding the role of agriculture in development (Hirschman 1958, Mellor 1995, WDR 2008, Gollin 2010). In particular, a few studies have argued that the current linkages observed in African agriculture are rather small (Dercon and Zeitlin 2009, Collier and Dercon 2009).

My focus on cocoa and cities in Ivory Coast and Ghana also connects with the study of cash crop windfalls, as they have been highly relevant to the economic history of developing countries. Using FAO data, we calculate that agricultural exports contributed to 53.4% of total exports for least developed countries in the 1960s, while it decreased to 21.4% in the 1990s as more countries specialized in mineral exports. Many countries are still dependent upon one agricultural commodity. Amongst 125 developing countries in 2000, agricultural exports represent more than 50% of total exports for 20 countries, and more than 20% for 50 of them.[8] Then, while mining windfalls have been extensively studied by the resource curse literature (Sachs and Warner 1999, Caselli and Michaels 2009, Vicente 2010, Michaels 2010), there are few studies on the economic effects of cash crop windfalls (Bevan, Collier and Gunning 1987, Maxwell and Fernando 1989, Angrist and Kugler 2008, Collier and Goderis 2009). Although the cash crop sector can be taxed by the state (Bates 1981), one might expect a large share of sectoral profits to go to those producing regions and households, thus having large development effects. Considering urbanization as a valid development outcome, our study informs on the local benefits of cash crop production. One can also use our framework to see if those effects might hold in the long run. African countries have highly benefited from their primary exports till the early 1980s, but the subsequent period has been characterized by macroeconomic disequilibria, social and political unrest and general impoverishment. Growth and poverty reduction have now resumed (Miguel 2009, Young 2010, Pinkovskiy and Sala-i-Martin 2010), but one can wonder whether this result is due to temporarily high terms of trade for African countries. Cash crop windfalls might then be subject to a resource curse in the form of "failed intertemporal redistribution".

Finally, both the development and economic geography literatures have wondered about the respective roles of randomness, inherited (physical) geography and built-in (economic) geography in spatial inequality. According to Davis and Weinstein (2002), three theories of the spatial distribution of economic activity have emerged: random growth, locational fundamentals and increasing returns. The random growth theory stipulates that cities emerge from stochastic processes, thus accounting for Zipf's Law (Gabaix 1999, Eeckhout 2004). The locational fundamentals theory argues that locations differ in their geographical endowments and this explains the spatial pattern of economic activity (Davis and Weinstein 2002). Within the development literature, several studies have highlighted the

[8]Most of them are in Sub-Saharan Africa, with well-known stories such as cocoa in Ghana and Ivory Coast, tea and coffee in Kenya, Rwanda and Uganda, coffee in Burundi and Ethiopia, tobacco in Malawi, groundnut oil and groundnuts shelled in Senegal and Gambia, cashew nuts in Guinea-Bissau, or cotton in Benin, Burkina-Faso or Mali.

role of physical geography in shaping economic development (Gallup, Mellinger and Sachs 1998, Engerman and Sokoloff 2000, Nunn and Puga 2009, Nunn and Qian 2010). Lastly, the increasing returns theory explains that population density has a positive effect on economic activity, as a result of better infrastructure, proximity to suppliers and consumers, labor pooling, localization and urbanization economies (Rosenthal and Strange 2004, Henderson 2005, Combes, Duranton, Gobillon and Roux 2011). The truth certainly lies between those three theories. Till the advent of slave and colonial trades, the Northern parts of Ghana and Ivory Coast have been relatively more densely populated. The economic potential of the Southern tropical forests was only discovered when cocoa could be produced there. As in Nunn and Qian 2010, it is the return to existing geographical endowments that has changed. Cocoa production has then launched an urbanization process which has become self-reinforcing. In new cocoa-producing regions, agglomeration economies have not arisen yet, and we can study the role of geographical endowments on development. In old cocoa-producing regions, geographical endowments are "lost", but agglomeration economies are realized.

The remainder of this paper is organized as follows. Section 2 details a theoretical discussion of rural-urban linkages when the rural-based cash crop sector booms and busts. Section 3 presents the agronomic and historical background of cocoa production in Ghana and Ivory Coast, while section 4 introduces the data and exhibits a graphic analysis of cocoa and urbanization. Section 5 explains our econometric framework. Section 6 displays our main results. Section 7 gives evidence for the various rural-urban linkages. Section 8 discusses the role of African cities as engines of growth, and section 9 concludes.

2 Theoretical Discussion

The country can be divided into districts with specific locational fundamentals. Those districts suitable to cocoa (the forested areas) urbanize when cocoa is produced (if the cocoa front has reached that district). Why would cocoa production lead to more urbanization? We need to develop a sequential model of urban settlement in a forest. In phase 1, which we label *no cocoa production*, a forested district is untouched and settlement is limited because it is difficult: land is not cleared yet, trees can be 80 meters tall, vegetation is thick, and humidity and mortality are high. In phase 2, which we label *new cocoa-producing area*, cocoa farmers settle there, the land is deforested and planted with cocoa trees, then cocoa production booms. The wealth and population of the district increase, but we need this increase to be spatially concentrated for cities to appear and to grow. In phase 3, which we label *old cocoa-producing area*, cocoa trees are old, income decreases, but cities do not collapse, on the contrary. This asks two questions: (i) What makes cities grow when cocoa booms? (ii) What makes cities resist when cocoa busts?

There are six interdependent channels through which cash crop production could drive urbanization. First, when cocoa farmers move to new areas, they settle in the few existing settlements or fund new settlements, to use them for the colonization of surrounding forests. Since some of those settlements are already urban or naturally evolve into cities, more cocoa farmers means a larger urban population. Second, production linkages could favor urban-based activities such as manufacturing or the collection and transportation of cocoa beans to be exported. Third, cocoa farmers spend their rising income on non-essential consumption goods. If those goods are *produced in* or *distributed through* the cities, then more cocoa income means more local opportunities in the cities. This can create a thriving trade sector. Those consumption linkages can also translate into production linkages if increased consumption is matched by domestic supply. Fourth, cocoa-producing districts can pay the fixed costs of the primitive accumulation of physical capital (basic amenities such as roads, schools, health centres, etc.), and this has a positive long-term effect on the size of those cities. Fifth, improved living standards and better infrastructure in those cities means reduced mortality and natural growth can quickly surpass rural-to-urban migration as the first source of urban growth. Sixth, the state can tax the profits of the cocoa sector to fund its own consumption, basically city-based civil servants. Yet, as the state might subsidize national and regional capitals and backward regions, we expect this public sector channel to influence urbanization in regions not producing cocoa.

When cocoa booms, all those effects can materialize. When cocoa busts, the settlement effect and consumption linkages are likely to vanish, while intersectoral production linkages, infrastructure and demographic growth are likely to explain urban resilience. Then, whether urban per capita income decreases or not is of utmost importance to know whether those cities can be engines of growth. On the one side, production linkages and infrastructure increase labor productivity. On the other side, decreased incomes in the cocoa sector and demographic growth reduce labor productivity. If labor productivity decreases when the cocoa wave has passed, cities pauperize and cash crop production is subject to a resource curse in the form of "failed intertemporal redistribution". In the very long run, the stock of virgin forest is exhausted and cocoa is no longer produced. All the districts that were suitable to cocoa production are in phase 3, where urban per capita income might be decreasing, stable or increasing, following which scenario is realized.

3 Agronomic and Historical Background

3.1 Agronomic Background

Cocoa is produced by "eating" the forest. Cocoa farmers go to a patch of virgin forest and replace forest trees with cocoa trees. Pod production starts after 5 years, peaks after 10 and continues up to 50 years. When cocoa trees are too old, cocoa farmers have no choice but to start a new cycle in a new forest. Indeed, removing forest trees alters the original environmental conditions and replanted cocoa trees are much less productive (Ruf 1991, Ruf 1995, Balac 2002).[9] That is why cocoa is a "migrant culture". Cocoa-producing countries have all experienced deforestation through regional cycles. When the forest rent is over, cocoa production moves to another country or continent[10]. The forested surface of Ivory Coast has decreased from 9 millions hectares in 1965 to 2.5 millions in 2000, while it has decreased from 8.2 millions in 1900 to 1.6 million in 2001 in Ghana. Recent studies have more generally emphasized the role of agricultural trade in deforestation (De Fries et al. 2010). Then, economic and political factors can accelerate or decelerate those cycles. Both countries have extracted almost the same quantity of cocoa throughout the 20th century (see fig. 4): 24 million tons in Ghana vs. 22.1 million tons in Ivory Coast. But, this amount has been extracted within a much shorter time period in Ivory Coast. In Ghana, three regional cycles did not overlap because the first two cycles were decelerated by extraordinary events and poor economic policy, which we describe just thereafter. In Ivory Coast, those regional cycles have been perfectly imbricated as no decelerating factor showed up during the period.

[9] By removing forest trees to plant cocoa trees, farmers change the environmental conditions that are essential to the long-term profitability of their cocoa farms. Cocoa trees are affected by: (i) spreading heliophile weeds, (ii) reduced pluviometry, (iii) a lower protection against winds, (iv) repeated attacks by new insects and diseases, (v) decreased soil fertility (the fertility of rainforests is contained in the trees and not the ground), and (vi) erosion. When cocoa trees are dying, cocoa farmers can plant new cocoa trees but the mortality rate of young cocoa trees is high while yields of those surviving trees are low. Discussions with agronomists have confirmed than replanting is twice more expensive than planting in a new forest. Here are two interesting quotes in Ruf 1991: "Before, cocoa plantations were productive; it's difficult now, young cocoa trees die..." (p.105), and "An old plantation is like an old dying wife. Medicine would be too expensive to keep her alive. It's better to keep the money for a younger woman [a new plantation]" (p.107).

[10] Cocoa production was dominated by Caribbean and South American countries till the early 20th century, then moved to Africa and is now spreading in Asia.

3.2 Historical Background

Cocoa was introduced to Ghana by missionaries in 1859, and reintroduced in 1878 by a Ghanaian blacksmith coming back from Equatorial Guinea. But it took 30 years before seeing cocoa being widely grown in Ghana, making it the world's largest exporter as soon as 1911. Cocoa production spread out in the Eastern province from Aburi Botanical Gardens, where the British sold cocoa seedlings at a very low price. Figure 7 shows the provinces of Ghana, the area suitable to cocoa production (basically, those regions with virgin forest one century ago) as well as Accra and Aburi (the historical starting point). Production peaked in the Eastern province in 1931, before plummeting as a result of both the Cocoa Swollen Shoot Disease and World War II which reduced international demand.[11] A second cycle started after the war in the Ashanti province. But low producer prices after 1958, restrictive migratory policies after 1969 and frequent droughts precipitated the end of this cycle.[12] Higher producer prices after 1983 pushed cocoa farmers to launch a third cycle in the Western province, the last forested region of Ghana.

Cocoa was first planted in Ivory Coast in 1888 by two French farmers not far from Abidjan. But it was not till 1910-1912 that the French governor decided to seriously promote cocoa production, thus trying to replicate the Ghanaian success story. Ivorians were originally reluctant to grow cocoa instead of food crops, except in Indénié (Abengourou) where local farmers heard of the increasing wealth of Ghanaian cocoa farmers (see figure 7, which exhibits Ivorian provinces, the area suitable to cocoa production and Abidjan and Abengourou). However, Ivorian production did not boom before the 1960s.[13] Cocoa moved from the Eastern forest to the Western Forest. Due to mounting deficits of the Caistab, the producer

[11] The Cocoa Swollen Shoot Disease was first recorded in 1938 in the Eastern region. Because no attempt could be made to control the disease until after World War II, millions of trees were killed and more millions had to be removed to try to control it (Thresh and Owusu 1986).

[12] First, Ghana after 1948 and Ivory Coast after 1960 fixed the producer price to protect farmers against fluctuant international prices. The Ghana Cocoa Marketing Board (COCOBOD) was in charge with cocoa in Ghana and the *Caisse de stabilisation et de soutien des prix des productions agricoles* (CSSPPA, or "Caistab") was its Ivorian equivalent. Yet, since the producer price was below the international price, this served as a taxation mechanism of the sector (Bates 1981). Second, the government enacted in 1969 the Aliens Compliance Order, which led to the massive exodus of laborers from neighboring countries and created labor shortages in the cocoa sector. Third, the 1982-1983 drought was the worse in fifty years and many cocoa farms were burnt.

[13] Two factors account for this Ivorian "lateness". First, cocoa did not reach the Ghanaian border before the 1910s. Ivorian production then increased but this boom was short-lived due to the Great Depression and World War II. Second, Ivorians had to provide the *corvée* (mandatory labour) for the colonial government, which forced them to grow food crops and coffee.

price was halved in 1989 and remained low thereafter, but this did not stop the colonization process as profits were still quite substantial.

Thus, in both countries, cocoa production was confined to the Southern (forested) areas and historically started in the South-East, for rather exogenous reasons. Cocoa being a "migrant culture", it moved to the West and within the South of both countries (as it could not move anywhere else). It is like a *pacman* game, except that the number of players have increased with time. As population growth was high and cocoa remained more profitable than other crops, more and more individuals specialized in cocoa production and participated to the colonization of the forest, thus accelerating the westward movement. Yet, in Ghana, the colonization of the forest has not been as linear as in Ivory Coast, due to natural events and more economic and political factors. As the forest rent is about to disappear, so will cocoa production, unless innovations increase yields in deforested land.

4 Data and Mapping

4.1 Data

To study the effects of cash crop production on urbanization in Ghana and Ivory Coast, we combine district-level data on cocoa production and cities over the period 1901-2000. We briefly describe the data here but the full methodology and the numerous sources used can be found in the data appendix. Cocoa and coffee production data mainly comes from reports published by the government agencies responsible for the organization of the cocoa production system in each country: the *Caisse de stabilisation et de soutien des prix des productions agricoles* (CSSPPA, or "Caistab") in Ivory Coast, and the Ghana Cocoa Marketing Board (COCOBOD) in Ghana. Our cash crop production data is available at the level of administrative districts in Ivory Coast, and at the level of *cocoa districts* in Ghana. Then, from census reports and administrative counts, we obtain the size of each locality of more than 5000 inhabitants for various years. We then geocode this data and we use GIS to extract urban population for any spatial decomposition we want. In Ivory Coast, we recreate urban and rural population data using the administrative districts. In Ghana, since cocoa districts significantly differ from administrative districts, we are only able to recreate urban population data. In the end, in our regression framework, we use a panel of 46 districts $\times$ 6 years (1948, 1955, 1965, 1975, 1988, 1998) = 276 observations in Ivory Coast, and 79 districts $\times$ 7 years (1901, 1911, 1921, 1931, 1948, 1960, 1970, 1984, 2000) = 711 observations in

Ghana. Between each district-year observation, we know how many tons of cocoa and coffee beans have been extracted and how many more urban inhabitants live there. Since we have a series of national cocoa and coffee producer prices, we work on the effect of the value of cash crop production (in 2000$) on urbanization. Figure 8 shows the value of cocoa production going to farmers between 1900 and 2000. Lastly, we use various Ivorian and Ghanaian household surveys and census data sets to discuss and give evidence for the various channels underlying this relationship: the 1985-88 *Living Standards Measurement Study* (LSMS), and the 1998 and 2002 *Enquêtes sur le Niveau de Vie des Ménages* (ENV) for Ivory Coast, and the 1987-88 and 2005 *Ghana Living Standard Surveys* (GLSS) and the *2000 Population and Housing Census* IPUMS sample for Ghana.

4.2 Cash Crop Production and Cities: Mapping

Figure 9 relates the district density of cash crop production value throughout the 20th century (in thousand 2000$ per sq.km.) and cities in 2000. As both countries had very few cities in 1900, cities in 2000 can be interpreted as the change in urbanization during the same period. The comparison of figures 7 and 9 confirms that cocoa and coffee can only be produced in forested areas. Then, figure 9 displays a strong spatial correlation between cash crop production and urbanization. Figures 10 to 15 show district density of cocoa production (in tons per sq.km.) and cities every ten years or so (the first date is for Ghana, the second for Ivory Coast): 1948 (fig. 10), 1960-1965 (fig. 11), 1970-1975 (fig. 12), 1984-1988 (fig. 13), 2000-1998 (fig. 14) and 2009 (fig. 15). As no census was performed yet during the 21st century, the 2009 map only reports cocoa production. Similar maps are created for previous years but are not reproduced. In 1948 (fig. 10), Ghanaian cocoa production has boomed in the Eastern province and is about to boom in the Ashanti province. Cocoa is also spreading to Ivory Coast. Most of Ghanaian cities are coastal cities, administrative centers or towns in the cocoa-producing areas. The Ivorian urban structure is mostly the result of the colonial administrative system. We then see cocoa production moving westward in both countries. In Ghana, the main cocoa-producing province is Ashanti in the 1960s and 1970s (fig. 11 and 12), and Western in the 1990s and 2000s (fig. 14 and 15). In Ivory Coast, production rapidly moves from the Eastern forest (fig. 10 and 11) to the Western forest (fig. 12, 13, 14 and 15). This mapping shows that the correlation between cash crop production and urbanization is also spatio-temporal.

5 Econometric Framework

5.1 Introductory Results: Long-Differences OLS Model

The main hypothesis we test is whether cash crop (cocoa and coffee) production drives urbanization. We focus on 1901-2000 Ghana and 1948-1998 Ivory Coast. We first run the following long-differences model for districts d:

$$\triangle U_d = \alpha + \delta C_d + \phi X_d + u_d \quad (1)$$

where our dependent variable is the change in urban population (in inhabitants) of district d between the first and last years (e.g., 1901 and 2000 in Ghana). Our variable of interest C_d is the total value of cash crop production (in million 2000$) during the same period. X_d is a set of district-level controls that we include to account for potentially contaminating factors. First, the Southern and Northern parts of each country differ as regards their economic, political and cultural history. As all the districts suitable to cocoa production are Southern districts, a dummy for being suitable should control for those regional characteristics. Second, we include dummies for having a national city (capital city and/or largest city) or a regional capital. Third, we also control for economic geography factors by inserting dummies for whether the district has a paved road, a railway or an international port in 2000, as well as Euclidean distance (in kms) to the coast. Fourth, we add the 1900-2006 average annual precipitations (in mms) and average maximal temperature (in °C) to control for food production and pre-existing settlement patterns. Lastly, as Ghana exports mining products (gold, manganese, diamond, bauxite), we include the total value of mineral production between 1901 and 2000.

Table 1 presents our results for 1948-1998 Ivory Coast (col. (1) and (2)) and 1901-2000 Ghana (col. (3) and (4)). Regressions in columns (1) and (3) only include a district dummy for having a national city, as those districts experience dramatic urban growth uncorrelated with cash crop production. Regressions in columns (2) and (4) include all the above-mentioned controls and give higher point estimates. As political and geographical factors cause some urbanization which cannot be explained by local cocoa production, omitting them plays as a downward bias. If we believe our estimates of columns (2) and (4), one million 2000$ of cash crop production between the first and last years respectively creates 143.9 and 106.3 urban inhabitants in Ivory Coast and Ghana. The development effect of mineral production is much lower, at 24.5 urban inhabitants per million

2000\$. We calculate the magnitude of this effect, that is to say how much of national urban growth between our first and last periods can be explained by this sole effect.[14] We find that cash crop production explains 84.5% of urban growth in Ivory Coast between 1948 and 1998 and 33.8% in Ghana between 1901 and 2000. Yet, the long-differences model does not identify the true effect of cash crop production on urbanization if some unobservable factors still contaminate their relationship. That is why we now investigate a fixed effects IV model.

5.2 Identification Strategy: Fixed Effects IV Model

We now run panel data regressions for districts d and years t of the following form:

$$U_{d,t} = \alpha_d + \beta_t + \delta C_{d,t} + \gamma U_{d,t-1} + \phi_t X_d + u_{d,t} \tag{2}$$

where α_d and β_t are district and year fixed effects, and our dependent variable is urban population (in inhabitants) of district d at time t ($U_{d,t}$), controlling for urban population at time $t-1$ ($U_{d,t-1}$). Since urban dependency varies across time, given agglomeration economies for instance, we allow the effect of $U_{d,t-1}$ to be period-specific (γ_t). Our variable of interest $C_{d,t}$ is the value of cocoa and coffee (in million 2000\$) produced between time $t-1$ and time t. X_d is the same set of controls as in the previous subsection, but their coefficients are now time-varying. Otherwise, they are included in the district fixed effect. $u_{d,t}$ are individual disturbances that are clustered at the district level. We have 46 districts and 6 time periods in Ivory Coast, hence 276 observations. We have 79 districts and 9 time periods in Ghana, hence 711 observations. Since we include lagged urban population, we drop one round and obtain respectively 230 and 632 observations.

The causality is unlikely to run from urbanization to cash crop production. Human settlement is difficult in rainforests. Farmers are just willing to overcome this constraint when they get a high income, which is the case with cocoa and coffee.[15] Then, cities constrain potential land for cash crop production. Additionally, cities are not useful to cash crop production, since it involves little technology.

[14] If δ is the impact of the value of cocoa production on urban population and if the total changes in urban population and cash crop production over our period are respectively ϕ and τ, the total magnitude of this effect is $\frac{\tau \times \delta}{\phi} * 100$. This gives us how many percents of the total change in urban population can be attributed to this sole effect.

[15] One could argue that farmers and logging companies work hand in hand to cut forest trees. Since district wood production data does not exist, our cash crop effect would then account for cocoa, coffee and wood production altogether. But this would not alter the message of our paper.

Yet, omitted factors such as transportation networks or rainfall could drive both production and urbanization. Although we add controls for political economy and geography, there might still be unobservable contaminating factors. Lastly, random measurement errors on cash crop production could downward bias our coefficient. This cannot be solved unless we instrument cash crop production.

Our instrumentation strategy is based on the fact that cocoa production is confined to suitable (forested) areas and is moving westward in both countries, as a result of historical factors. We first create a dummy equal to one if more than 50% of district area is suitable to cocoa production. Figure 16 displays those districts that are suitable using this cut-off. We then arbitrarily divide the territory into longitude bands of one degree, using the centroid of each district. Figure 17 reproduces those longitude bands. We assume the cocoa front is moving one degree westward every X time period. We take $X = 2$ for Ghana and $X = 1$ for Ivory Coast. Indeed, regional cycles were not imbricated in Ghana, contrary to Ivory Coast, as explained in section 3.2. The instrument is the dummy "being suitable to cocoa production" interacted with a dummy "being *on* the cocoa front". Then, cocoa production is high both at the cocoa frontier and in the adjacent longitude bands. The right band is the cocoa frontier at time $t-1$ and production does not immediately collapse. The left band is the next cocoa frontier (at time $t+1$) and production is already increasing. Thus, comparing the sole cocoa frontier to the other longitude bands gives a less powerful instrument than considering the cocoa frontier plus the two adjacent bands. The new instrument is then the dummy "being suitable to cocoa production" interacted with a dummy "being *close to* the cocoa front". We test both. Here is the full IV model:

$$U_{d,t} = \alpha'_d + \beta'_t + \delta' C_{d,t} + \lambda F_{d,t} + \gamma' U_{d,t-1} + \phi'_t X_d + v_{d,t} \quad (3)$$

$$C_{d,t} = \alpha''_d + \beta''_t + \Pi S_d * F_{d,t} + \lambda' F_{d,t} + \gamma' U_{d,t-1} + \phi''_t X_d + w_{d,t} \quad (4)$$

with S_d a dummy equal to one if the district is suitable to cocoa and $F_{d,t}$ a dummy equal to one if the district happens to be *on* or *close to* the cocoa front, depending on which IV we use. The other variables are defined as above (see (2)). The coefficients of interest are δ from equation (1) and δ' from equation (2), the OLS and IV estimated impacts of the value of cash crop production on urbanization.

To conclude, we instrument cash crop production by just saying "it has to move westward, within the South, as it cannot go anywhere else". Then, whether it is going North-Westward or South-Westward, e.g. due to transportation networks, is irrelevant since the IV permits us to get rid of those contaminating factors.

6 The Effect of Rural Windfalls on Urbanization

6.1 Local Cash Crop Production and Local Urbanization

Tables 2 presents the results for the fixed effects models (with controls), for 1948-1998 Ivory Coast and 1901-2000 Ghana. For each country, we show in panel A the OLS estimate in column (1), the IV estimate in column (2), and the IV estimate dropping the largest city (Abidjan in Ivory Coast, Accra in Ghana) in column (3). As their urbanization process is disconnected from the local context (and thus local cocoa production), dropping them should improve our estimates. We report in panel B the first stage of our IV regressions. We privilege the IV estimates using the instrument "suitable to cocoa production" * "being *close to* the cocoa front" as the instrument is then powerful enough for both countries (see the Kleibergen-Paap rk Wald F stat which we report). The instrument "suitable to cocoa production" * "being *on* the cocoa front" is more powerful for Ivory Coast but much weaker for Ghana. Hopefully for us, the wave has no independent positive impact on cash crop production or urbanization (see the coefficients of "Close to the cocoa front"). Only its interaction with cocoa suitability has a positive impact on the value of cash crop production (see the coefficients of "Suitable * Close to the cocoa front").

The IV estimates are higher than the OLS estimates, especially when dropping the main city. This discrepancy could be explained by measurement errors or downward omission biases. If we believe our estimates from columns (3) and (6), one million 2000$ of cash crop production increases urbanization by 89.6 inhabitants in Ivory Coast and 83.1 inhabitants in Ghana. The two effects are not significantly different, which is comforting for our strategy. Those two effects are lower than those found in the long-differences model, where one million 2000$ of cash crop production increases urbanization by 143.9 inhabitants in Ivory Coast and 106.3 inhabitants in Ghana. First, long-differences models are less sensitive to measurement errors than fixed effects model (Griliches and Hausman 1986, McKinnish 2008), but the IV should correct for this. Second, long-differences models estimates long-term effects. Cash crop production at time t ($C_{d,t}$) increases urbanization at time t ($U_{d,t}$), which has then a more than proportional impact on urbanization at time $t+1$ ($U_{d,t+1}$). Thus, by collapsing all the periods, we also capture this long-term effect which goes to through agglomeration economies. By comparison, in the fixed effects IV model, we explain short-term variations in urbanization with short-term variations in the value of cash crop production. Third, the long-differences model could be subject to upward omission biases, which we correct with the fixed effects IV model. To conclude, the true effect could be in between the estimated short-term and long-term effects.

Regarding magnitude, and accounting for the fact that the IV estimate might be upward biased by 15% for Ivory Coast (given a lower IV F-stat), we find that local cash crop production respectively explains 38.2% and 69.4% of non-primate urbanization (excluding the main city) in Ghana and Ivory Coast. Dropping other national cities such as Bouake (the second largest city) and Yamoussoukro (the capital city from 1983) in Ivory Coast and Kumasi (the second largest city) in Ghana does not alter the coefficients, but the magnitude increases to 47.4% in Ghana and 80.6% in Ivory Coast. Lastly, using those coefficients to estimate the magnitude of the cash crop effect in suitable districts only, we find that cash crop production explains 58.8% and 89% of urbanization in Ghana and Ivory Coast. Those magnitudes are lower for Ghana, the reason being that the production of cocoa has been less concentrated in time, causing short-term effects to be lower than long-term effects.[16] In the end, we believe that our Ghanaian estimates constitute a lower bound of the true impact of cash crop production on urbanization.

6.2 Specification and Robustness Checks

In table 3, we show that those IV results are robust to specification checks, with Ivory Coast in columns (1) to (4) and Ghana in columns (5) to (8). Columns (1) and (5) respectively report those results from columns (1) and (4) in table 2. As our panel data model includes a lag of the dependent variable, our estimates are subject to a *dynamic panel bias* (Nickell 1981). We therefore estimate in columns (2) and (6) a model where we consider the change in urban population as the outcome without including any lag of the dependent variable. Coefficients are almost unaffected. In columns (3) and (7), we explain urban density (district urban population per sq.km.) by value density (district value of cash crop production per sq.km.) but this does not alter our message. Lastly, in columns (4) and (8), our variable of interest is cocoa and coffee production in volume (tons).

We now run a battery of checks. First, we verify that the periodicity of our data does not impact our results. We run the same model, but we divide the change in urban population and the value of cocoa production between $t-1$ and t by the number of years between $t-1$ and t, so that we consider annualized changes. Results are the same. Second, we try other suitability cut-off (25, 50 or 75%) for

[16]This is confirmed by the fact that the dependency rates of urbanization, the coefficients γ' of $U_{d,t-1}$ in model (3), are significantly higher for Ghana than for Ivory Coast.

our IV strategy, but the results are unaffected. Third, we test that our results are not driven by a specific period. Fourth, in a regression discontinuity design spirit, we restrict our sample to those districts whose centroid are less than X km from the physical border between forested and savannah regions. We try different bandwidths, such as 300 and 400 km (respectively 150 and 200 km on each side of the border). Results are unaltered. Fifth, we wonder whether local urbanization is influenced by "neighboring" urbanization and/or cash crop production. We run the same model, this time also including regional urbanization at time $t-1$ and/or regional value of cash crop production between $t-1$ and t. The main results are unchanged, and the coefficients of those variables are small and insignificant. Cash crop production has no regional externalities. We also account for spatially auto-correlated standard errors by testing clustering at the regional level instead. Lastly, some Ivorian districts neighboring Ghana might have benefited from smuggling, as the producer price was slightly higher on the Ivorian side for most of the post-independence period. We drop those districts and results are unaffected. They are also unaffected if we drop the Ghanaian districts bordering Ivory Coast.

6.3 Decomposing the Population Effect of Cash Crops

In table 4, we investigate whether this urbanization effect is part of a more general population effect where cash crop production increases both urban and rural densities. As our Ghanaian cocoa production data uses the spatial decomposition of *cocoa districts* and not *administrative districts*, we have no total population data. We focus on Ivory Coast 1965-1998, for which we have both urban and rural population data. We study the impact of cash crop production value on total, urban and rural populations (respectively col. (1), (2) and (3)), and on the urbanization rate (in %) (col. (4)). We only report the OLS (see equation (1)) as the instrument is too weak for the rural population regression, making the estimated coefficient unreliable. We find that one million 2000$ increases population by 62.8 inhabitants and that this population effect is concentrated in city as no significant impact is found for rural population (see col. (3)). This is true if we consider rural density instead. This is again confirmed by the fact that cash crop production has increased the urbanization rates of those producing districts (col.(4)).

We then decompose urban growth (col. (2)) into the urban growth of cities already existing at time $t-1$ (col. (5)) and the urban growth of new cities, those passing the 5000 threshold between $t-1$ and t (col.(6)). We find a slightly but not significantly higher effect for new cities. Cash crop production thus reinforces the power of pre-existing urban settlements. It also has a strong "city formation" power. Since the urban growth associated to each new city is small (from less than 5000 to more than 5000 between $t-1$ and t), such a strong urban growth effect of new cities must result from many new cities. This is confirmed by column (7), where 1 billion 2000$ is giving 7 new cities. Given the total value of cash crop production between 1965 and 1998, this gives 281 new cities, while there have been 313 new cities over the period. Thus, cash crop production explains 89% of city formation. Results for Ghana are not shown but give rather similar results.

6.4 Urban Growth in New vs. Old Cocoa-Producing Areas

We distinguish what happens in new and old-cocoa producing districts vs. the non cocoa-producing districts. We create a dummy equal to one if per capita cocoa production increases between $t-1$ and t and 0 otherwise (those districts are located in new cocoa-producing areas). Then, we create a dummy equal to one if per capita cocoa production decreases between $t-1$ and t and 0 otherwise (those districts are located in old cocoa-producing areas). We consider as an outcome total urban growth (col. (1) of table 5), urban growth in existing cities (col. (2)), urban growth in new cities (col. (3)) and the number of cities (col. (4)). As we do not have district population data for Ghana, we are unable to calculate per capita production. We nevertheless have regional population data for Ghana, so we use regional per capita production to create the same set of dummies. Results being very similar in both countries, we only show those results for Ivory Coast.

Results from column (1) indicate that old cocoa-producing regions experience higher urban growth: each old cocoa-producing district is receiving 84,600 urban inhabitants, while it is 66,100 for each new cocoa-producing district. Yet, as there are much fewer old cocoa-producing districts, new cocoa-producing districts are the main contributors to urban growth. Nevertheless, this indicates that cities in old cocoa-producing regions do not collapse, on the contrary. They grow even further, as if cash crops just launch a self-reinforcing urbanization process. Since no difference is noticeable as regards urban growth of existing cities (col. (2)), this difference between old and new cocoa-producing regions come from new cities, as confirmed by columns (3) and (4). This could be due to urban decentralization. As the existing cities become more congested, there are strong incentives for other centers to appear. But this could also result from a cocoa front within the district. As land close to the already existing cities is fully exploited, the latest cocoa farmers entering the district colonize the more remote forests where no settlement can be found. Those remote settlements become cities the next generation, when aggregate district per capita production is already decreasing.

7 Rural-Urban Linkages

Results of subsection 6.1 indicate that cash crop production respectively explains 58.8% and 89.9% of urbanization in the forested areas of Ghana and Ivory Coast. If the Ghanaian magnitude is a lower bound estimate given the discrepancy between short-term and long-term effects, we can take the Ivorian magnitude as a benchmark and we need to explain why cash crop production explains around 90% of urban growth in forested regions. We now use our household survey and census data to give evidence for the channels behind this relationship.

7.1 Economic Sectors and Urbanization in Forested Areas

Table 6 shows that a large share of the urban workforce belongs to the primary sector in the forested areas of Ivory Coast and Ghana (more than one third in the late 1980s), many of them being cocoa farmers. But this share has been decreasing with time to the benefit of the secondary sector in Ghana, and the tertiary sector in both countries. Yet, it is noticeable that the share of the secondary sector is quite low. Then, to get a better understanding of the mechanisms behind the relationship between cash crops and cities, we take as an example the *Centre-Ouest* region of Ivory Coast (see fig. 7), which was the main cocoa-producing area of Ivory Coast in the 1990s. There have been 460 thousand additional urban inhabitants between 1988 and 1998. From table 7, we learn that 35.6% of this urban growth is due to an increase in the urban workforce, the rest (64.4%) corresponding mostly to children, housewives or young adults searching for work. We find a similar pattern in other regions. Thus, for every urban inhabitant who works, we mechanically get two more inhabitants. To understand total urban growth, we thus need to explain the growth of the urban workforce. Decomposing the growth of urban employment across the three economic sectors, we find that 56.5% of this growth is driven by the primary sector, and 52.6% by the tertiary sector. People have left the secondary sector over time, as its contribution is negative (-9.1%). Cocoa farmers have notably contributed to this primary sector effect, as they explain 34.4% of total employment growth. Those main sectors behind the tertiary sector effect are trade (24.3% of total employment growth), personal services (17.6%), transport and communications (8.8%), education and health (2.7%), business services and banking (2%). The number of civil servants has decreased over time, as the contribution of administration is negative (-2.8%). We now use these results to analyze individually the various mechanisms at stake.

7.2 The Settlement of Cash Crop Farmers

When cocoa farmers move to new areas, they settle in the few existing settlements or fund new settlements, to use them for the colonization of surrounding forests. Then, some of those settlements where cocoa farmers settle are urban or naturally evolve into cities. We thus expect a high share of urban inhabitants to be cocoa farmers in new cocoa regions. This is confirmed by the fact that the settlement of cocoa farmers explain 34.4% of total employment growth in the cities of the *Centre-Ouest* region in Ivory Coast. We could also calculate that those cocoa farmers living in city are wealthier than those living in countryside. Their urban residency could represent a preference for an urban way of life.

7.3 Production Linkages

Cocoa production has few backward production linkages. It has remained traditional, with a low level of mechanization and a low adoption of fertilizers and insecticides. Then, it has few forward production linkages. First, cocoa beans are not processed locally but directly exported abroad. Second, we could imagine that the profits associated to cocoa production serve to fund investments in other sectors. Yet, the cocoa sector is dominated by a myriad of smallholders and it is rather unlikely that they deposit their savings in banks of the formal sector and fund large-scale projects. They could still use that money to run small business, such as shops or textile workshops. Nonetheless, we find that the size of the urban secondary sector has been reduced by 32.0% over the period in the *Centre-Ouest* region of Ivory Coast. Third, cocoa beans must be transported from cocoa-producing areas to the ports for export. The logistics of cocoa beans export involves local and regional depots, transportation companies and port administration. Since their activity is mostly urban-based, we could wonder whether this translates into more urbanization. But we find that people working directly into the export of cash crops only represent 0.8% of the tertiary sector. In the end, cash crop production has few production linkages in our context.

7.4 Consumption Linkages

To study consumption linkages, we keep taking as an example the Centre-Ouest region of Ivory Coast. First, the influx of cocoa-producing households has accounted for 76.5% of total (urban plus rural) population change in this region between 1985-88 and 1998. By comparison, the influx of cocoa farmers has accounted for 61.5% of total population change in the Western province of Ghana (the last regional cycle). Second, cocoa farmers are much wealthier than the non-cocoa farmers of the same region. Using household survey data, we regress household expenditure on a dummy equal to one if the household produces cocoa and we include village fixed effects so as to compare cocoa producers and non-cocoa farmers *within* the same village. Cocoa farmers are respectively 31.3% and 28.4% wealthier than their non-cocoa counterparts in the forested areas of Ivory Coast in 1985-88 and 2002. In the forest regions of Ghana, they are respectively 22.1% and 20.2% relatively wealthier in 1987-88 and 2005. Third, we look at the structure of household expenditure for cocoa and non-cocoa farmers in the forest regions of each country. Table 8 displays this allocation for the cocoa farmers in Ivory Coast (1985-88 and 2002) and Ghana (1987-88 and 2005). Total consumption is divided into three consumption aggregates: home production, food expenses and other (non-food) expenses (in % of total consumption). We then divide each consumption aggregate into six consumption subaggregates (in % of the consumption aggregate). The whole structure is rather stable through space and time. If we look at the structure of household expenditure in 1985-88 Ivory Coast, food represents 32.1% (home production) plus 25.8% (food expenses) = 57.9% of household expenditure. Although we cannot identify which good is *urbanizing*, we guess that food and non-food expenses imply the growth of the urban-based trade sector.[17] We then find that non-cocoa farmers have almost the same consumption structure (not reproduced here), although they are 20-30% poorer. This is in line with Dercon and Zeitlin (2009) who explain that the Engel's curve can be invalidated for low levels of income. Nonetheless, as cocoa farmers are 20-30% wealthier than their non-cocoa counterparts, they still spend 20-30% more on urbanizing goods.[18]

[17] Dercon and Hoddinott (2005) show on Ethiopian data that rural households go to the nearest market town to: (i) buy 47% of crop inputs, (ii) sell a large share of crop production, (iii) get non-agricultural income by selling artisanal products, and (iv) purchase 55% of their consumables.

[18] We also find that cocoa farmers own more durable goods that non-cocoa farmers. For each good, we regress a dummy equal to one if the household owns this good on a dummy equal to one if the household produces cocoa, including village fixed effects. Results not reproduced here show that cocoa producers more often owns a fan, a radio, a TV, a bicycle, a bike and a car.

To summarize, cocoa farmers have accounted for 76.5% of population change in the *Centre-Ouest* region of Ivory Coast between 1985-88 and 1998. Those cocoa farmers are around 30% wealthier than non-cocoa farmers, and both cocoa-producing and other farming households spend 57.9% of their income on urbanizing goods. Back-of-the-envelope calculations suggest the aggregate income spent on urban goods has increased by 23.0% compared to a situation where the region had been *counter-factually* colonized by non-cocoa farmers only. This increase reaches 61.2% compared to a situation where only half of cocoa farmers could have been replaced by non-cocoa farmers, which is a more plausible hypothesis given the fixed costs of deforestation. We can relate those magnitudes to the contribution of the tertiary sector to urban employment growth over the same period (52.6%). A 61.2% increase in urban expenditure would then give a 52.6% increase in tertiary employment, thus showing small returns to scale in this sector. The fact that employment decreases in the secondary sector, although local supply must have increased to match rising incomes, implies that goods were brought from other regions or from abroad. Cash crop production might then have had production linkages at the national level. But this is not the case if increased consumption is matched by imports, which macroeconomic data seems to suggest.

7.5 Infrastructure Investments

From table 7, we learn that "transport and communications" and "education and health" have respectively contributed to 8.8% and 2.7% of urban employment growth in the *Centre-Ouest* region of Ivory Coast. This in line with cash crop farmers willing to spend a high share of their income on those goods. This also indicates that infrastructure investments (roads, schools, health centers, etc.) might have followed cash crop production. We now use various data sets to show that infrastructure today is spatially correlated with cocoa production in the past, for both rural and urban settlements. Cities of the cocoa-producing regions could have better infrastructure, which makes them grow relatively more. Or rural settlements of those regions could have better infrastructure, which helps their urbanization.

We first build an original GIS data set of paved roads for Ivory Coast for those years 1965, 1975, 1988 and 1998 (to be consistent with our population data). We estimate for each district-year the total length of paved roads (in kms). In a similar spirit to equation (2) (see subsection 5.2), we regress the length of paved roads at time t on the value of cocoa production between $t-1$ and t, controlling for the length of paved roads at time $t-1$ and including district and time fixed effects. We find that cocoa production explains at least 50% of paved road building between 1965 and 1998 (results not reported but available upon request).

Second, using household survey data for Ivory Coast, we estimate the share of rural and urban inhabitants with access to electricity, private tap water and toilet in 1998-2002. We drop those observations corresponding to Abidjan and Bouake. We regress those shares on a dummy equal to 1 if per capita production decreases between 1965 and 1998 (the old cocoa-producing districts) and a dummy equal to one if it increases (the new cocoa-producing districts). Northern districts are taken as a control group. We expect residents of the old cocoa-producing regions to have a better access to infrastructure. Results are reported in table 9. We do not notice any significant difference across cities of each group of districts (see col. (2), (4) and (6)). But villagers of the old cocoa-producing areas have a higher access to electricity (col. (1)), private tap water (col. (2)) and toilet (col. (3)). Considering the share of children attending school (col. (5) to (8)), this share is higher in the old cocoa-producing region than in the new cocoa-producing region where it is higher than in the Northern districts. We also have at our disposal administrative data on the number of primary and secondary schools in 1994 and the number of hospitals and health centers in 2003. This data does not distinguish rural and urban settlements, but it indicates that old cocoa-producing districts have more secondary schools and health centers per capita (results not shown but available upon request). No difference is noticed for primary schools and hospitals.

Third, we use the 2000 Ghanaian Facility Census to test whether cocoa production has permitted infrastructure investments. For each administrative district and each type of settlement (rural/urban), we estimate the share of inhabitants less than 10 kms away from various facilities: primary school, junior secondary school (JSS), senior secondary school (SSS), health center, hospital, post office, telephone. We then use 2000 Population and Housing Census data to calculate for each district and type of settlement the share of inhabitants with access to electricity, private tap water and toilet. We create a dummy equal to one if this district belongs to a region where cocoa production boomed in the 1930s (the very old cocoa-producing districts), one dummy equal to one if it belongs to a region where cocoa production boomed in 1960s (the old cocoa-producing districts) and a dummy equal to one if it belongs to a region where cocoa production boomed in the 1990s (the new cocoa-producing districts). Northern districts are taken as a control group. We expect very old cocoa-producing districts to be better endowed than old cocoa-producing districts, themselves better endowed than new cocoa-producing districts and non-producing districts. We drop observations corresponding to Accra and Kumasi. Results from table 10 show that both cities and villages of the very old and old cocoa-producing areas have a better infrastructure.

To conclude, although we cannot definitively prove that cocoa production causes infrastructure, the previous analysis illustrates that the old cocoa-producing regions are relatively more well-endowed in infrastructure than the other regions, and this is true along several dimensions: road, electricity, water, hygiene, education, health and communications. This is important for explaining why cities keep growing and rural settlements urbanize in old cocoa-producing regions.

7.6 Natural Increase and Urban Growth

In countries of the First Industrial Revolution, mortality was much higher in city than in countryside (Bairoch 1988, Clark and Cummins 2009). As a result, cities could not grow without massive influx of rural migrants. As both the rural-urban mortality gap and the urban-rural income differential were closing, natural increase became the main contributor to urban growth (Williamson 1990, Voigtländer and Voth 2010). In the Third World, mortality has always been much lower in city, making natural increase a strong factor of urbanization. To study this issue, we look at the urban and rural dimensions of the demographic transition in Ivory Coast and Ghana. Following Williamson (1990), we know that:

$$U_t - U_{t-1} = (UCRB_{t-1} - UCRD_{t-1}) * U_{t-1} + IM_{t-1} + UEM_{t-1} \quad (5)$$

$$R_t - R_{t-1} = (RCRB_{t-1} - RCRD_{t-1}) * R_{t-1} - IM_{t-1} + REM_{t-1} \quad (6)$$

where U_t and R_t are urban and rural population at time t, $U_t - U_{t-1}$ is urban population change between $t-1$ and t, and $R_t - R_{t-1}$ rural population change between $t-1$ and t. CRB and CRD are crude rate of birth and crude rate of death in city (U) and countryside (R). IM is the number of internal migrants, i.e. rural-to-urban migrants. UEM and REM are the number of external (foreign) migrants going to the cities and the countryside. For the model to be valid, the internal migration estimates (M_{t-1}) in the urban and rural equations must be consistent. For each inter-census subperiod in Ivory Coast (1965-1975, 1975-1988 and 1988-1998) and Ghana (1960-1970, 1970-1984 and 1984-2000), we know urban and rural growth, and the urban and rural crude rates of birth and death (the difference between the two being the crude rate of natural increase $CRNI$). Since we have separate data for Abidjan/Accra and other cities, our model has one rural equation, one equation for other cities and one equation for the main city.

We first look at the evolution of urban/rural crude rates of birth, death and natural increase between the 1960s and the 1980s (see table 11). At independence, there is no urban-rural natality differential. Yet, we observe a strong reduction in urban natality after 1960 in Ghana and 1975 in Ivory Coast. Regarding mortality in 1965, it was lower in Abidjan/Accra than in the other cities, where it was lower than in the countryside. Throughout the period, it has been decreasing across all places of residence, but this evolution was more impressive in countryside. In Ivory Coast, natural increase in Abidjan and the other cities peaked in 1975, while rural natural increase peaked in 1988. In Ghana, natural increase had already peaked in Accra and the other cities in 1960, while it remained high in countryside. This confirms that the demographic transition is first "urban" then "rural".

We then use equations (4) and (5) to gauge the contribution of natural increase to urban/rural growth. For each intercensal subperiod, we estimate the urban/rural population change that can be explained by natural increase. We then compare it with the observed population change. The difference between both population changes is necessarily explained by either internal or external migration. Results are reported in table 12. In Ivory Coast, the contribution of natural increase has risen from 31% in 1965-75 to 80% 1988-98 in Abidjan and from 20% in 1965-75 to 45% in 1988-98 in the other cities. In Ghana, the contribution of natural increase to urban growth has peaked during the 1970-84 period. For instance, in the other cities, it increased from 56% in 1960-70 to 90% in 1970-84. Most of urban growth at that time was fed by newborns and not rural migrants. Then, with the end of the political and economic crisis and a new cocoa boom in the Western region, migration has become again the main contributor to urban growth. If one considers the last period for both countries, natural increase explains around 45% of urban growth in non-capital cities.

To conclude, natural increase has become a determining factor of urban growth, thus making urbanization a self-reinforcing process. By permitting household and community investments in physical and human capital (better housing conditions, education, health), cocoa production has contributed to long-term urban growth.

8 Discussion [To be completed]

8.1 Mid-Conclusion

Sections 5 and 6 have demonstrated that local cash crop production could respectively explains 47.7% and 80.6% of urbanization (excluding national cities) in

Ghana and Ivory Coast. Thus, a large share of urbanization in our two African countries is driven by agriculture, and not by manufacturing or tradable services. Section 7 has then shown that for every urban inhabitant who works, there are two urban inhabitants that do not work, mostly because they are too young to work or because they are uninterested in working. Understanding urban growth means understanding the growth of urban employment. We find that most of this growth is explained by the primary sector (mostly the settlement of cocoa farmers in city) and the tertiary sector (mostly workers involved in the trade and transportation of goods and the personal services industry). Indeed, cocoa production has strong consumption linkages, which could explain the development of this latter sector. But we could not find evidence for local production linkages. It is striking that the size of the secondary sector shrinks when cocoa booms. Therefore, cash crop windfalls create cities, but those cities have a specific economic composition consisting of farmers, traders and service employees. Although we cannot prove that this specialization is not growth-enhancing in the long run, we think that such cities only thrive as long as the cash crop windfall has not ended. If cash crop production busts, those cities are "demographically" resilient as we observe that cities keep growing. But income data could reveal that per capita income then decreases, which would mean that cities pauperize.

8.2 An Urban Dutch Disease

Using census data from Ghana, we now study whether cities of the old cocoa-producing regions produce more manufactured goods and are more economically diversified. For each individual aged between 25 and 60, we regress a dummy equal to one if she has a job on a set of dummies for whether she lives in a very old / old / new cocoa-producing area vs. non-producing area (see col. (1) of table 13). We find that the participation rate is only slightly higher in those cities of the cocoa-producing areas (+ 3/4% compared to a national average of 0.86). We then regress a dummy for whether she works in the primary, secondary or tertiary sector (see col. (2)). Logically, we find that the primary sector is disproportionately represented in the new cocoa-producing areas. But it is striking to find that this sector is still over-represented in old and very old cocoa-producing areas (compared to the secondary and tertiary sectors), as if the economic composition of those regions had only slightly changed in a few decades. We then compute district Hirschman-Herfindahl diversity indices, and we find that the very and old cocoa-producing districts are actually less economically diversified than Northern cities (see col.

(3)). If anything, this confirms that cash crop production has had few production linkages. Otherwise, we would expect those cities to be more diversified when cash crop production disappears. Then, the fact that old cocoa-producing regions produce less manufactured goods and are less economically diversified indicates that economic resources are absorbed by the primary sector when it booms. This is rather similar to the labor effect of a Dutch disease. Lastly, we do not have income data yet. But our prediction is that per capita income is not higher in old cocoa-producing districts than in new cocoa-producing districts or even Northern non-producing districts.

8.3 The Potential Effects of Resource Exhaustion on Cities

Whether cash crop production can create growth-enhancing cities and have a positive long-term impact on per capita income is an essential issue as cocoa production is doomed to vanish in both Ivory Coast and Ghana in a few decades. Cocoa is produced by "eating" the forest, and both countries are eating their last available forests (see fig. 15). Their entire southern territory will then be in phase 3, with old cocoa farms. Beyond the microeconomic effects already discussed above, resource exhaustion will have a huge macroeconomic impact via a collapse of government revenue and spending. By fixing the producer price below the international price and overvaluing their exchange rate, these governments have captured a large share of the cocoa windfalls to fund their own consumption and investments (Bates 1981). For the period 1961-2006, the average taxation rate is 43.8% in Ivory Coast and 49.5% in Ghana. Figures not reproduced here show that post-independence government consumption and investment are highly correlated with the cocoa tax in both Ivory Coast and Ghana.

As we do not have data on the spatial distribution of government spending, we use household survey and census data to guess who might be affected by a fall in government spending. First, as most state employees are concentrated in city, this fall would harm the urban sector. We calculate that 80.4% of Ivorian public employees and 70% of Ghanaian public employees live in city. They respectively represent 10.8% and 11.1% of urban labor force in Ivory Coast and Ghana. Second, in line with the primacy literature (Davis and Henderson 2003), we expect the main city to be disproportionately favored by the central government. Then, since governments also adopt redistributive regional policies, we expect the state to be more represented per capita in the poorest regions of the country, i.e. the North. In Ivory Coast, the number of public employees per thousand inhabitants is 54.9

in the main city, 36.2 in Northern Cities and 18.1 in Southern Cities. In Ghana, those figures are respectively 58.7, 43 and 40.7. A cut in government spending would affect more the main city and Northern cities.

9 Conclusion

We look at the effect of cash crop (cocoa and coffee) production on urbanization in two African countries, Ghana and Ivory Coast, during the 20th century. First, we find that cash crop production explains more than half of urbanization (excluding national cities) in both countries. Thus, a large share of African urbanization might come from agriculture. Second, agricultural windfalls create cities with a specific economic composition, consisting of farmers, traders and service employees. Third, those cities of the old cocoa-producing regions have a smaller manufacturing sector and are less economically diversified, as if those cities were stuck with their agricultural origin. Yet, more evidence needs to be provided to illustrate an urban Dutch disease (especially on per capita income). Fourth, this makes those cities and those countries still highly dependent upon the production and price of primary commodities. Current African growth is then not sustainable if it is due to temporarily high terms of trade. Fifth, this might suggest African cities are unlikely to be powerful engines of growth in the long run. Sixth, we can wonder why manufacturing and tradable services are "missing" in Africa. Lastly, the urban demographic transition might be a curse if future newborns cannot find employment. African cities would then be doomed to pauperize.

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Data Appendix

Urban Data

Population data on Ivory Coast comes from the following documents: (i) *Annuaire Statistique de l'A.O.F.* 1949-1951 & 1950-1954, (ii) *Rapports périodiques des gouverneurs et chefs des services* 1895-1940 and *Rapports Statistiques* 1818-1920, collections of the French colonial archives, (iii) *Population de l'A.O.F. par canton et groupe ethnique 1950-1951*, Haut-Commissariat de l'A.O.F., Service de la statistique générale, (iv) *Répertoire des villages de la Côte d'Ivoire 1955*, Service de la statistique générale et de la mécanographie, Territoire de Côte d'Ivoire, (v) *Inventaire Economique de la Côte d'Ivoire 1947-1958*, (vi) *Côte d'Ivoire 1965: Population, Etudes régionales 1962-1965*, Synthèse, Ministère du Plan de Côte d'Ivoire, (vii) *Recensement général de la population 1975*, (viii) *Population de la Côte d'Ivoire, Analyse des données démographiques disponibles* 1984, Ministère de l'Economie et des Finances de Côte d'Ivoire, Direction de la statistique, (ix) *Recensement général de la population et de l'habitat 1988*, (x) *Recensement général de la population et de l'habitation 1998*. Given changes in administrative boundaries, we are only able to get a consistent district sample of total population for the 1965-1998 period. As regards urban data, we know the size and the geographical coordinates of any locality with more than 5000 inhabitants for the period 1901-1998. Using GIS, we are then able to recalculate district urban population for any spatial decomposition. Since we have cocoa production for 46 districts, we use those boundaries to estimate total and urban populations.

Population data on Ghana comes from the reports of the following *Population and Housing Censuses*: 1901, 1911, 1921, 1931, 1948, 1960, 1970, 1984 and 2000. As regards total population data, administrative boundaries have changed with time and we cannot get a consistent sample. As regards urban data, we know the size and the geographical coordinates of any locality with more than 5000 inhabitants for the whole period. Using GIS, we are able to recalculate district urban population for any spatial decomposition. Since we have cocoa production for 79 *cocoa districts*, we use those boundaries to estimate urban population.

Cash Crop Production Data

Cocoa and coffee production data on Ivory Coast is obtained by crossing the information contained in different sources. For the pre-independence period, our major sources are: (i) *Annuaire Statistique de l'A.O.F.* 1949-1951, and (ii) *Inventaire Economique de la Côte d'Ivoire 1947-1958*. They list cocoa production at the colonial district level for the 1945-1958 period. We then use more minor sources to obtain data for the pre-1945 period as well as more refined spatial data for the post-1944 period: (i) *Documentary Material on Cacao for the Use of the Special Committee on Cacao of the Inter-American Social and Economic Council*, 1947, Pan American Union, (ii) *Félix Houphouët-Boigny: Biographie*, Frédéric Grah Mel (2003), Editions du CERAP, Maisonneuve & Larose, (iii) *Problèmes de l'économie rurale en A.O.F.*, Ch. Robequain (1937), *Annales de Géographie* 46 (260): 137-163, (iv) "Immigration, Land Transfer and Tenure Changes in Divo, Ivory Coast, 1940-80", Robert Hecht (1985), *Africa: Journal of the International African Institute* 55(3): 319-336, and (v) "Immigration et économie de plantation dans la région de Vavoua (Centre-Ouest Ivoirien)", P. Brady (1983), unpublished thesis University of Paris 10. For the post-independence period, our major sources are: (i) *Annuaire rétrospectif de statistiques agricoles et forestières 1900-1983*, Ministère de l'agriculture et des eaux et des forêts de Côte d'Ivoire, 1983, (ii) *Caisse de stabilisation et de soutien des prix des productions agricoles (CSSPPA)*, the agricultural marketing board of Ivory Coast till its dismantling in 1999, and (iii) "Pesage systématique du café et du cacao à l'entrée des usines de conditionnement et de transformation", 2008-2009, Audit, Control & Expertise. They list cocoa production at the district level for the 1959-2008 period. Those major sources were then complemented with more refined spatial data from: (i) *La boucle du cacao en Côte d'Ivoire, Etude régionale des circuits de transport* ,P. Benvéniste (1974), Travaux et Documents de l'ORSTOM, and (ii) *Atlas de Côte d'Ivoire, 1971-1979*, Ministère du Plan de Côte d'Ivoire. In the end, we obtain cocoa and coffee production in tons for 46 districts for the 1948-2008 period. We calculate how much tons of cocoa and coffee production were produced between each census year for each district. We then use the following sources to obtain the producer prices (in CFA Francs) for the period 1948-2006: (i) *Annuaire Statistique de l'A.O.F. 1949-1951 & 1950-1954*, and (ii) FAOSTAT. We obtain CFAF/$ exchange rate data and $ deflator data from: (i) UN 2010, (ii) IFS 2010, World Bank, (iii) Teal 2002. By multiplying cocoa and coffee productions and the corresponding deflated producer price (in 2000$), we get the annual deflated total value (also in 2000$) of cash crop production going to farmers. Likewise, we calculate how much 2000$ of cash crop production were earned between each census year for each district.

Cocoa production data on Ghana is obtained similarly, although only for the main crop, which extends from October to July. But this is not an issue as the main crop amounts to 94.7% of the total crop on average during the period 1948-2000. For the pre-independence period, we use the following documents: (i) *1927 Yearbook of the Gold Coast Department of Agriculture*, Government of Ghana, (ii) *A Historical Geography of Ghana*, Dickson (1968), (iii) *Report on the Cocoa Industry in Sierra Leone, and Notes on the Cocoa Industry of the Gold Coast*, Cadbury (1955). Those documents respectively display a very detailed map of cocoa production for the years 1926, 1936 and 1950. We can then use GIS to recalculate cocoa production using any district boundaries. We obtain national and regional data from the following documents: (i) *The Gold Coast Cocoa Farmer*, by Polly Hill (1956), Oxford University Press, (ii) *The Gold Coast Cocoa Industry: Prices, Production and Structural Change*, Christer Gunnarson (1978), Economic History Association, Lund, Sweden, (iii) *Annual Reports and Accounts of the Ghana Marketing Board* 1957-1962, 1965, 1970, (iii) *Enquiry into the Gold Coast Cocoa Industry, 1918-1919*, W.S. Tudhope (1919), (iv) *Reports of the Department of Botanical and Agricultural Department* 1904-1955, Government of the Gold Coast, and (v) *The Economics of Cocoa Production and Marketing*, Proceedings of Cocoa Economics Research Conference in Legon, April 1973, University of Ghana. For the post-independence period, all the following documents list cocoa production at the *cocoa district* level for their respective year: (i) *Analysis of Cocoa Purchases by Societies, Districts and Regions* are repots edited by the Produce Department of the Ghana Cocoa Marketing Board and available for the following years: 1961-1975, 1989 and 1994-1999, (ii) *Ghana Cocoa Marketing Board Newsletter* 1966-1974, (iii) *Ghana Cocoa Marketing Board Monthly Progress Reports* 1972-1985, and (iv) a summary of 2001-2009 district cocoa purchases which was obtained from the Ghana Cocoa Marketing Board. Since district boundaries change from year to year, we use GIS to reaggregate our data so as to get a consistent sample of district cocoa production. In the end, we obtain cocoa production for districts for the following years: 1926, 1936, 1950, 1961-1982, 1989, 2001. We use linear interpolation to recalculate cocoa production for the missing years. Lastly, we calculate how much tons of cocoa production were produced between each census year for each district. We then use the following sources to obtain the producer price (in 2000 Ghanaian 2nd Cedi) for the period 1900-2006: (i) *Cocoa in the Ghanaian Economy*, Merryl Bateman (1965), unpublished thesis, MIT, (ii) FAOSTAT, (iii) "Export Growth and Trade Policy in Ghana in the Twentieth Century", Teal (2002), The World Economy 25: 1919-1937. We obtain Cedi/$ official and parallel exchange rate data and $ deflator data from: (i) Dordunoo, Cletus. 1994. "The Foreign Exchange Market and the Dutch Auction System in Ghana." *AERC Research Paper* no 24, (ii) Lawrence H. Officer. 2009. "Exchange

Rates Between the United States Dollar and Forty-one Currencies." *Measuring Worth*, (iii) Teal 2002, and (iv) UN 2010. We use parallel exchange rate data when the black market premium is significantly different from 0. By multiplying cocoa production and the deflated producer price (in 2000$), we get the annual deflated total value (also in 2000$) of cocoa production going to farmers. Likewise, we calculate how much 2000$ of cocoa production were earned between each census year for each district.

Other Data

We collect data on other characteristics of Ivory Coast and Ghana. Forest data comes from land cover GIS data compiled by Globcover 2009. The data displays those areas with virgin forest or mixed virgin forest/croplands, which were areas with virgin forest before it was cleared for cash crop production. Then, climate data comes from *Terrestrial Air Temperature and Precipitation: 1900-2006 Gridded Monthly Time Series, Version 1.01*, 2007, University of Delaware.

For Ivory Coast, we first use three household surveys to calculate a range of statistics that we use for our empirical analysis: (i) the 1985-1988 Living Standards and Measurement Study (LSMS), and (ii) the 1998 and 2002 *Enquêtes sur le niveau de vie des ménages* (ENV). Third, in addition to the household surveys, we use the following infrastructure datasets: (i) a GIS data set on paved roads in 1955, 1965, 1975, 1988 and 1998 using information from Michelin road maps and the book *Elephants d'Afrique 1995-2000*, (ii) the 1988 urban infrastructure census (*Recensement des Infrastructures des Communes Urbaines*), (iii) allocation maps of primary and secondary schools in 1992 from the book *Elephants d'Afrique 1995-2000*, (iv) allocation map of health facilities in 2003 from the WHO website (http://gamapserver.who.int/mapLibrary/default.aspx). Fourth, demographic transition data is compiled crossing information from the following documents: (i) reports of *Recensement général de la population et de l'habitation 1998*, (ii) *Temps des villes, temps des vivres : L'Essor du vivrier marchand en Côte-d'Ivoire*, by Jean-Louis Chaléard (2000), Karthala, (iii) *La Côte d'Ivoire à l'aube du XXIe siècle : Défis démographiques et développement durable*, by Georges Tapinos, Philippe Hugon and Patrice Vimard (2003), Karthala, (iv) *Données démographiques sur la croissance des villes en Côte d'Ivoire*, by Jean-Paul Duchemin et Jean-Pierre Trouchaud (1969), Cahiers de l'ORSTOM, Série Sciences Humaines, 1-1969. Fifth, the cocoa tax is estimated using annual FAO data on the international price in dollars of cocoa beans and exchange rate UN data. Sixth, data on government total spending, consumption and investment comes from the African Development Indicators dataset (WB).

For Ghana, we first use three household surveys and two censuses to calculate a range of statistics that we use for our empirical analysis: (i) the 1987-88 and 2005 *Ghana Living Standard Survey*, (ii) the 2000 *Population and Housing Census* IPUMS sample, and (iii) the 2000 *Facility Census*. Second, mining data is collected from the following documents: (i) *The Mineral Industry of the British Empire and Foreign Countries 1913-1919*, Imperial Mineral Resources Bureau, (ii) *Reports of the Mines Department of the Gold Coast* 1931-1958, and (iii) *The Mineral Industry of Ghana* 1963-2000, USGS Reports. Third, demographic transition data is compiled crossing information from the following documents: (i) Patterson, David. 1979. "Health in Urban Ghana: the Case of Accra 1900-1940." *Social Science and Medicine* 13B: 251-268, (ii) Caldwell, J.C. 1967. "Fertility Differentials as Evidence of Incipient Fertility Decline in a Developing Country: The Case of Ghana." *Population Studies* 21(1): 5-21, (iii) *The Population of Ghana 1974*, CICRED Report, (iv) *Demographic and Household Survey* 1988, (v) Agyei-Mensah, Samuel. 2005. "The Fertility Transition in Ghana Revisited." Paper prepared for the 25th IUSSP International Population Conference, Tours, and (vi) *Ghana's Development Agenda and Population Growth: The Unmet Need for Family Planning*, National Population Council 2006.

Table 1: Cash Crop Production and Urbanization, Long-Differences Model, OLS.

Dependent Variable:	Change in District Urban Population (Pop. in ≥5000 Localities)			
	Ivory Coast, 1948-1998		**Ghana, 1901-2000**	
	OLS (1)	*OLS + Ctrls* (2)	*OLS* (3)	*OLS + Ctrls* (4)
District value of cocoa + coffee production	103.8***	143.9***	63.4***	106.3***
(between t_0 and T, millions of 2000$)	[37.7]	[46.9]	[15.8]	[31.6]
District value of mineral production				24.5*
(between t_0 and T, millions of 2000$)				[12.9]
Observations	46	46	79	79
R-squared	0.47	0.79	0.85	0.90
All Controls	N	Y	N	Y

Note: Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are clustered at the regional level. We add the following controls: (a) political economy: dummies for being suitable to cocoa production (= Southern district), for having a national city (capital city and/or largest city) or a regional capital, (b) economic geography: dummies for whether the district has a paved road, a railway or an international port in 1965, as well as Euclidean distance (in km) to the coast, (iii) physical geography: 1900-2006 average annual precipitations (in mms) and average maximal temperature (in °C), and (iv) value of mineral production between $t-1$ and t for Ghana.

Table 2: Cash Crop Production and Urbanization, Fixed Effects Model, IV.

Dependent Variable:	District Urban Population (Pop. in ≥5000 Localities)					
	Ivory Coast, 1948-1998			**Ghana, 1901-2000**		
	OLS	*IV*	*IV, Excl. Abidjan*	*OLS*	*IV*	*IV, Excl. Accra*
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Main Equation						
District value of cocoa + coffee prod.	57.1***	70.5***	89.6***	32.4*	78.9***	83.1***
(between $t-1$ and t, millions of 2000$)	[14.2]	[21.7]	[21.1]	[16.8]	[29.7]	[28.2]
Close to the cocoa front		2,932.7	2,594.4		-136.9	-1,150.3
		[3,324.1]	[2,897.7]		[1,462.3]	[1,269.7]
Panel B: 1st Stage						
Suitable * Close to the cocoa front		199.7***	166.3***		86.5***	86.4***
		[69.3]	[59.6]		[17.4]	[18.2]
Close to the cocoa front		6.5	11.4		-4.3	-4.5
		[38.0]	[36.5]		[5.6]	[6.2]
Kleibergen-Paap rk Wald F stat		7.2	7.8		22.6	22.6
Observations	230	230	225	632	632	624
R-squared	0.99	0.99	0.95	0.99	0.99	0.96
Year Fixed Effects	Y	Y	Y	Y	Y	Y
District Fixed Effects	Y	Y	Y	Y	Y	Y
Year Dummies * Lag of Dep. Var.	Y	Y	Y	Y	Y	Y
All Controls	Y	Y	Y	Y	Y	Y

Note: Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are clustered at the district level. We add the following controls whose coefficient is time-varying: (a) political economy: dummies for being suitable to cocoa production (= Southern district), for having a national city (capital city and/or largest city) or a regional capital, (b) economic geography: dummies for whether the district has a paved road, a railway or an international port in 1965, as well as Euclidean distance (in km) to the coast, (iii) physical geography: 1900-2006 average annual precipitations (in mms) and average maximal temperature (in °C), and (iv) value of mineral production between $t-1$ and t for Ghana.

Table 3: Cash Crop Production and Urbanization, IV, Specification Checks.

Dependent Variable:	District Urban Population (Pop. in ≥5000 Localities, Excl. Abidjan and Accra)							
	Ivory Coast, 1948-1998				**Ghana, 1901-2000**			
	Level (1)	△ (2)	Density (3)	Level (4)	Level (5)	△ (6)	Density (7)	Level (8)
Main Equation								
District value of cocoa + coffee prod.	89.6***	97.2***			78.9***	99.7*		
(between $t-1$ and t, millions of 2000$)	[21.1]	[20.7]			[29.7]	[51.5]		
District value density of cocoa + coffee			70.6***				78.5	
(between $t-1$ and t, millions of 2000$/sq.km.)			[22.2]				[70.3]	
District cocoa + coffee production				0.13***				0.08**
(between $t-1$ and t, tons)				[0.03]				[0.03]
Kleibergen-Paap rk Wald F stat	7.8	6.3	9.5	9.7	22.4	21.8	22.7	18.2
Observations	225	225	225	225	632	632	632	632
R-squared	0.95	0.97	0.96	0.96	0.99	0.69	0.99	0.99
Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
District Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
Year Dummies * Lag of Dep. Var.	Y	N	Y	Y	Y	N	Y	Y
All Controls	Y	Y	Y	Y	Y	Y	Y	Y

Note: Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are clustered at the district level. All the regressions include year and district fixed effects. Except in columns (2) and (5) where the outcome is the change variable, we also include year dummies interacted with the lag of the dependent variable. We add the following controls whose coefficient is time-varying: (a) political economy: dummies for being suitable to cocoa production (= Southern district), for having a national city (capital city and/or largest city) or a regional capital, (b) economic geography: dummies for whether the district has a paved road, a railway or an international port in 1965, as well as Euclidean distance (in km) to the coast, (iii) physical geography: 1900-2006 average annual precipitations (in mms) and average maximal temperature (in °C), and (iv) value of mineral production between $t-1$ and t for Ghana.

Table 4: Cash Crop Production and Total, Urban and Rural Populations, Ivory Coast, 1965-1998.

Dependent Variable:	**Population**			**Urban Population**			
	Total	Urban	Rural	Urban. Rate	In Old Cities	In New Cities	Number of Cities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
District value of cocoa + coffee prod.	61.5**	62.8***	4.5	0.01***	33.7***	44.3***	0.007***
(between $t-1$ and t, millions of 2000$)	[24.2]	[13.4]	[23.1]	[0.00]	[11.4]	[12.7]	[0.002]
Observations	135	135	135	135	135	135	135
R-squared	0.94	0.92	0.85	0.78	0.90	0.56	0.79
Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y
District Fixed Effects	Y	Y	Y	Y	Y	Y	Y
Year Dummies * Lag of Dep. Var.	Y	Y	Y	Y	Y	Y	Y
All Controls	Y	Y	Y	Y	Y	Y	Y

Note: Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are clustered at the district level. We add the following controls whose coefficient is time-varying: (a) political economy: dummies for being suitable to cocoa production (= Southern district), for having a national city (capital city and/or largest city) or a regional capital, (b) economic geography: dummies for whether the district has a paved road, a railway or an international port in 1965, as well as Euclidean distance (in km) to the coast, (iii) physical geography: 1900-2006 average annual precipitations (in mms) and average maximal temperature (in ˚C), and (iv) value of mineral production between $t-1$ and t for Ghana.

Table 5: Population Change in Old vs. New Cocoa-Producing Areas, Ivory Coast 1965-1998, OLS.

Dependent Variable:	**District Urban Population** (Thousands of Inhabitants)			
	All Cities	In Old Cities	In New Cities	Number of Cities
	(1)	(2)	(3)	(4)
Old Cocoa Area	84.6***	57.2***	56.5***	7.0***
	[10.5]	[7.6]	[11.5]	[1.7]
New Cocoa Area	66.1***	59.3***	39.9***	4.6***
	[13.6]	[5.1]	[6.8]	[0.9]
Observations	135	135	135	135
R-squared	85.3	88.2	56.5	70.3
Year Fixed Effects	Y	Y	Y	Y
District Fixed Effects	Y	Y	Y	Y
Year Dummies * Lag of Dep. Var.	Y	Y	Y	Y
All Controls	Y	Y	Y	Y

Note: Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are clustered at the district level. We add the following controls whose coefficient is time-varying: (a) political economy: dummies for being suitable to cocoa production (= Southern district), for having a national city (capital city and/or largest city) or a regional capital, (b) economic geography: dummies for whether the district has a paved road, a railway or an international port in 1965, as well as Euclidean distance (in km) to the coast, (iii) physical geography: 1900-2006 average annual precipitations (in mms) and average maximal temperature (in °C), and (iv) value of mineral production between $t-1$ and t for Ghana.

Table 6: Sectoral Decomposition of Urban Workforce (in %) in Forested Areas.

	Ivory Coast		**Ghana**	
	1985-88	2002	1987-88	2005
Primary Sector [Cocoa farmers]	35.6 [20.2]	28.0 [8.4]	35 [5.3]	22.3 [5]
Secondary Sector	13.8	11.8	12.2	17.9
Tertiary Sector	50.6	60.2	52.8	59.8
Total	100	100	100	100

Note: We use our census data and the 1985-88 LSMS and 2002 ENV household surveys for Ivory Coast and the 1987-88 and 2005 GLSS (1, 2 & 5) household surveys for Ghana to estimate the sectoral decomposition of the urban workforce in forested areas.

Table 7: Sectoral Decomposition of Urban Growth in *Centre-Ouest* Region, Ivory Coast.

***Center-Ouest* Region, 1985-88 - 2002**	
% of urban growth due to:	
Non-Workforce	64.4
Workforce	35.6
% of change in urban workforce due to:	
Primary Sector [Cocoa farmers]	56.5 [34.4]
Secondary Sector	-9.1
Tertiary Sector	52.6
Of which:	
- Trade	24.3
- Personal Services	17.6
- Transport & Communications	8.8
- Education & Health	2.7
- Business Services & Banking	2
- Administration	-2.8
Total	52.6

Note: We use the 1985-88 LSMS and 2002 ENV household surveys to estimate the sectoral decomposition of urban growth in the *Centre-Ouest* region of Ivory Coast.

Table 8: Allocation of Household Expenditures for Cocoa-Producing Households (in %).

Ivory Coast, Forest, 1985-1988 and 2002								
	1988	2002		1988	2002		1988	2002
Home Production	32.1	28.9	Food Expenses	25.8	27.9	Other Expenses	42	43.2
Of which (%):			*Of which (%):*			*Of which (%):*		
Starchy roots	51.7	40.1	Seafood	30.0	29.0	Clothing	22.9	21.7
Cereals	25.2	24.5	Cereals	16.1	22.3	Transfers & Events	15.0	14.3
Vegetables	10.1	11.9	Sweets	13.9	8.6	Health & Hygiene	14.0	23.6
Meat	5.8	6.3	Alcohol	9.3	3.1	Housing	14.0	17.4
Oils	5.2	9.1	Meat	8.6	8.5	Education	12.2	6.6
Fruits	1.3	5.8	Oils	8.0	8.0	Bills & Fuel	9.1	11.3

Ghana, Forest, 1987-1988 and 2005								
	1988	2005		1988	2005		1988	2005
Home Production	36.3	18.5	Food Expenses	33.3	37.2	Other Expenses	30.1	44.3
Of which (%):			*Of which (%):*			*Of which (%):*		
Starchy roots	59.5	67.5	Seafood	35.8	35.1	Clothing	26.6	19.4
Vegetables	10.9	8.8	Starchy roots	17.5	6.0	Health & Hygiene	20.5	16.3
Cereals	9.9	6.7	Vegetables	11.0	12.1	Housing	9.4	10.6
Fruits	7.8	4.2	Cereals	9.1	17.5	Transfers & Events	11.9	10.9
Meat	6.2	4.0	Meat	8.0	7.4	Education	6.9	15.2
Oils	5	6	Oils	6	5	Bills & Fuel	8.9	11.3

Note: We use the 1985-88 LSMS and 2002 ENV household surveys for Ivory Coast and the 1987-88 and 2005 GLSS (1, 2 & 5) household surveys for Ghana to estimate the allocation (in %) of total household expenditure for cocoa-producing households in the Forest regions of both countries. We first show the allocation across three consumption aggregates: home production, food expenses and other expenses. Second, for each of those consumption aggregates, we show the six main consumption subaggregates and their contribution (in %) to the value of the consumption aggregate.

Table 9: Cocoa Production and Infrastructure Investments, Ivory Coast, 1998-2002.

Dependent Variable:	**Share of Households with Access to**						**Share of Children Attending School**			
	Electricity		Private Tap Water		Toilet		6-11 yo		12-15 yo	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Old Cocoa Area	0.28***	-0.03	0.09***	-0.04	0.46***	0.05	0.18**	-0.05	0.20**	-0.02
	[0.09]	[0.11]	[0.03]	[0.08]	[0.15]	[0.07]	[0.08]	[0.06]	[0.08]	[0.08]
New Cocoa Area	0.12**	-0.03	-0.02	-0.07	0.16**	-0.01	0.13***	-0.03	0.1	0.01
	[0.05]	[0.05]	[0.02]	[0.06]	[0.07]	[0.06]	[0.05]	[0.05]	[0.06]	[0.05]
Observations	44	45	44	45	44	45	44	45	44	45
R-squared	0.22	0.01	0.2	0.03	0.27	0.01	0.19	0.02	0.11	0

Note: Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. The 1998 EP and 2002 ENV surveys are used to estimate the share of inhabitants with access to private tap water, electricity, and toilets, as well as the share of children attending school for two age groups: 6-11 corresponding to primary schooling, and 12-15 corresponding to secondary schooling. Old cocoa areas correspond to districts whose per capita cocoa production has been decreasing between 1965 and 1998 (mostly in the Eastern Forest). New cocoa areas correspond to districts whose per capita cocoa production has been increasing between 1965 and 1998 (mostly in the Western Forest). Northern districts are taken as a control group.

Table 10: Cocoa Production and Infrastructure Investments, Ghana, 2000.

Dependent Variable:	**Share of Inhabitants ≤ 10 Kms From**									
	Primary School		JSS		SSS		Health Centre		Hospital	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Very Old Cocoa Area	0.04*	0.00	0.13*	0.00	0.16*	0.07*	0.14*	0.02**	0.12*	0.10
	[0.01]	[0.00]	[0.05]	[0.00]	[0.07]	[0.03]	[0.05]	[0.01]	[0.05]	[0.06]
Old Cocoa Area	0.04*	0.00	0.12	0.00	0.18	0.02	0.14*	0.01	0.17*	0.09
	[0.01]	[0.00]	[0.05]	[0.00]	[0.08]	[0.03]	[0.06]	[0.01]	[0.06]	[0.07]
New Cocoa Area	0.03	0.00	0.10	0.00	0.00	0.00	0.00	0.01	0.09	-0.02
	[0.01]	[0.00]	[0.05]	[0.00]	[0.07]	[0.03]	[0.05]	[0.01]	[0.05]	[0.06]
Observations	104	100	104	100	104	100	104	100	104	100
R-squared	0.27	0.00	0.30	0.00	0.13	0.04	0.19	0.02	0.13	0.03

Dependent Variable:	**Share of Inhabitants ≤ 10 Kms From**				**Share of Inhabitants with Access to**					
	Post Office		Telephone		Electricity		Private Tap		Toilet	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Very Old Cocoa Area	0.36**	0.11*	0.33**	0.17**	0.11**	0.12**	0.02**	0.07**	0.60**	0.27*
	[0.06]	[0.04]	[0.04]	[0.04]	[0.02]	[0.02]	[0.00]	[0.02]	[0.14]	[0.08]
Old Cocoa Area	0.30*	0.10*	0.25*	0.12*	0.15**	0.14**	0.01	0.01	0.55**	0.25*
	[0.09]	[0.04]	[0.08]	[0.04]	[0.03]	[0.02]	[0.01]	[0.03]	[0.14]	[0.09]
New Cocoa Area	0.12	0.01	0.13*	0.05	0.12**	0.18**	0	0	0.42*	0.21*
	[0.06]	[0.04]	[0.04]	[0.04]	[0.02]	[0.02]	[0.00]	[0.02]	[0.14]	[0.08]
Observations	104	100	104	100	104	100	104	100	104	100
R-squared	0.33	0.15	0.24	0.08	0.29	0.2	0.07	0.05	0.61	0.39

Note: Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are clustered at the region level. The 2000 Facility Census is used to calculate the average distance (in km) to various types of facility. JSS and SSS are junior and senior secondary schools. The 2000 Population and Housing Census is used to estimate the share of inhabitants with access to electricity, private tap water and toilets. Observations corresponding to Accra and Kumasi are dropped. Very old cocoa areas correspond to districts whose maximum cocoa production was reached during the 1930s. Old cocoa areas correspond to districts whose maximum cocoa production was reached in the 1960s. New cocoa areas correspond to districts whose maximum cocoa production was reached in the 1990s. Northern districts are taken as a control group.

Table 11: Crude Rates of Birth, Death and Natural Increase per Place of Residence.

Ivory Coast 1965-1998				**Ghana 1960-2000**			
	Crude Rate of (%o)				Crude Rate of (%o)		
	Birth	Death	Natural increase		Birth	Death	Natural increase
Rural				**Rural**			
1965	50	30	20	1960	52	23	29
1975	48	20	28	1970	51	21	30
1988	52	15	37	1984	48	17	31
Urban				**Urban**			
1965	46	26	20	1960	49	20	29
1975	51	14	37	1970	45	14	31
1988	42	13	29	1984	37	14	23
Abidjan				**Accra**			
1965	47	14	33	1960	43	14	30
1975	50	9	41	1970	36	7	28
1988	42	9	33	1984	34	11	23

Note: see data appendix for details.

Table 12: Contribution (%) of Natural Increase and Migration to Population Change.

	Ivory Coast 1965-1998			Ghana 1960-2000	
	Natural increase (%)	Migration (%)		Natural increase (%)	Migration (%)
Rural			**Rural**		
1965-1975	84	16	1960-1970	227	-127
1975-1988	131	-31	1970-1984	139	-39
1988-1998	162	-62	1984-2000	264	-164
Urban			**Urban**		
1965-1975	20	80	1960-1970	56	44
1975-1988	46	54	1970-1984	90	10
1988-1998	45	55	1984-2000	46	54
Abidjan			**Accra**		
1965-1975	31	69	1960-1970	33	67
1975-1988	62	38	1970-1984	76	24
1988-1998	80	20	1984-2000	39	61

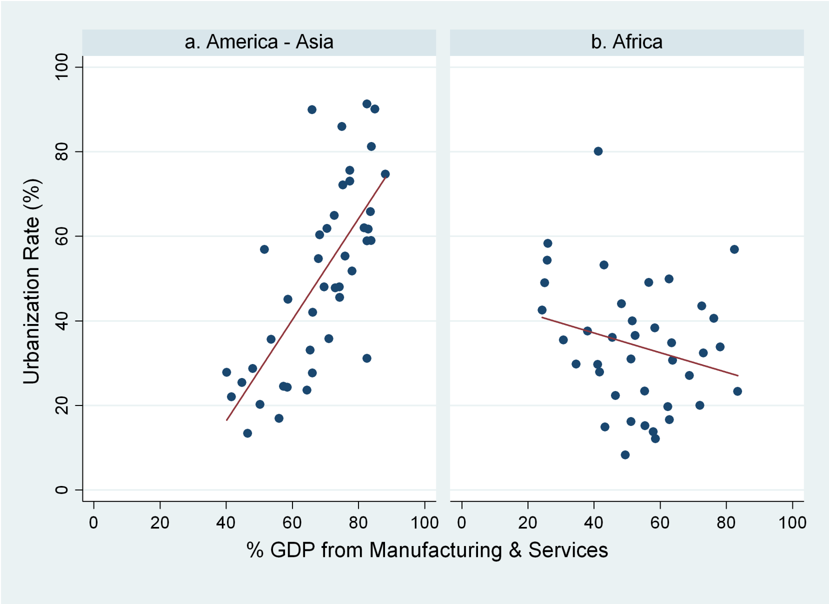
Note: We use historical data on population and crude rates of birth and death by place of residence (rural / urban / main city) to estimate the contribution (in %) of natural increase and migration to population change for each subperiod between two census dates. For each subperiod - place of residence, the contribution of natural increase (in %) is calculated as initial population times the rate of natural increase between year t-1 and year t over population change times 100. The contribution of migration (in %) is calculated as 100 minus the contribution of natural increase. Unfortunately, we cannot distinguish internal and external migration.

Table 13: Urban Labor Force in Ghana (2000): Participation, Composition and Diversification.

Dependent Variable:	**Is Employed**	**Is Employed in Sector:**			**Diversity Index**
		Primary	Secondary	Tertiary	Hirschman-Herfindahl
	(3)	(1)	(2)	(6)	(7)
Very Old Cocoa Area	0.03*	0.08*	-0.04**	-0.04	0.04**
	[0.02]	[0.04]	[0.01]	[0.02]	[0.02]
Old Cocoa Area	0.04**	0.07**	-0.01	-0.06***	0.02*
	[0.02]	[0.03]	[0.01]	[0.02]	[0.01]
New Cocoa Area	0.03***	0.20***	-0.04***	-0.16***	0.04***
	[0.01]	[0.03]	[0.01]	[0.02]	[0.01]
National Average	0.86	0.23	0.22	0.55	0.23
Observations	300392	257439	257439	257439	257439
R-squared	0.01	0.13	0.01	0.05	0.44
Controls	Y	Y	Y	Y	Y

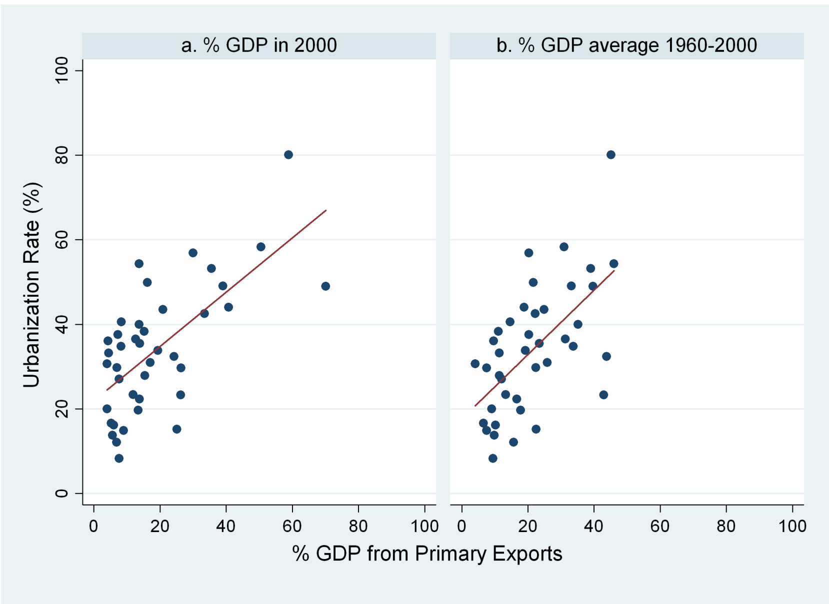
Note: Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are clustered at the region level. The 2000 Population and Housing Census is used to create dummies equal to one if a 25-60 year-old individual has an occupation and whether she is employed in the primary/secondary/tertiary sector. We also estimate a Hirschman-Herfindahl diversification index using a classification with 11 sectors. Results are robust to a diversity index based on a classification with 63 subsectors. Very old cocoa areas correspond to districts whose maximum cocoa production was reached during the 1930s. Old cocoa areas correspond to districts whose maximum cocoa production was reached in the 1960s. New cocoa areas correspond to districts whose maximum cocoa production was reached in the 1990s. Northern districts are taken as a control group. Controlling variables are: age-sex dummies, district dummies for having a national city (Accra, Kumasi), a regional capital, a port, a paved road, a railway, being a coastal district, and distance to the coast (in km).

Figure 1: Manufacturing and Service Sectors and Urbanization in Developing Countries in 2000.



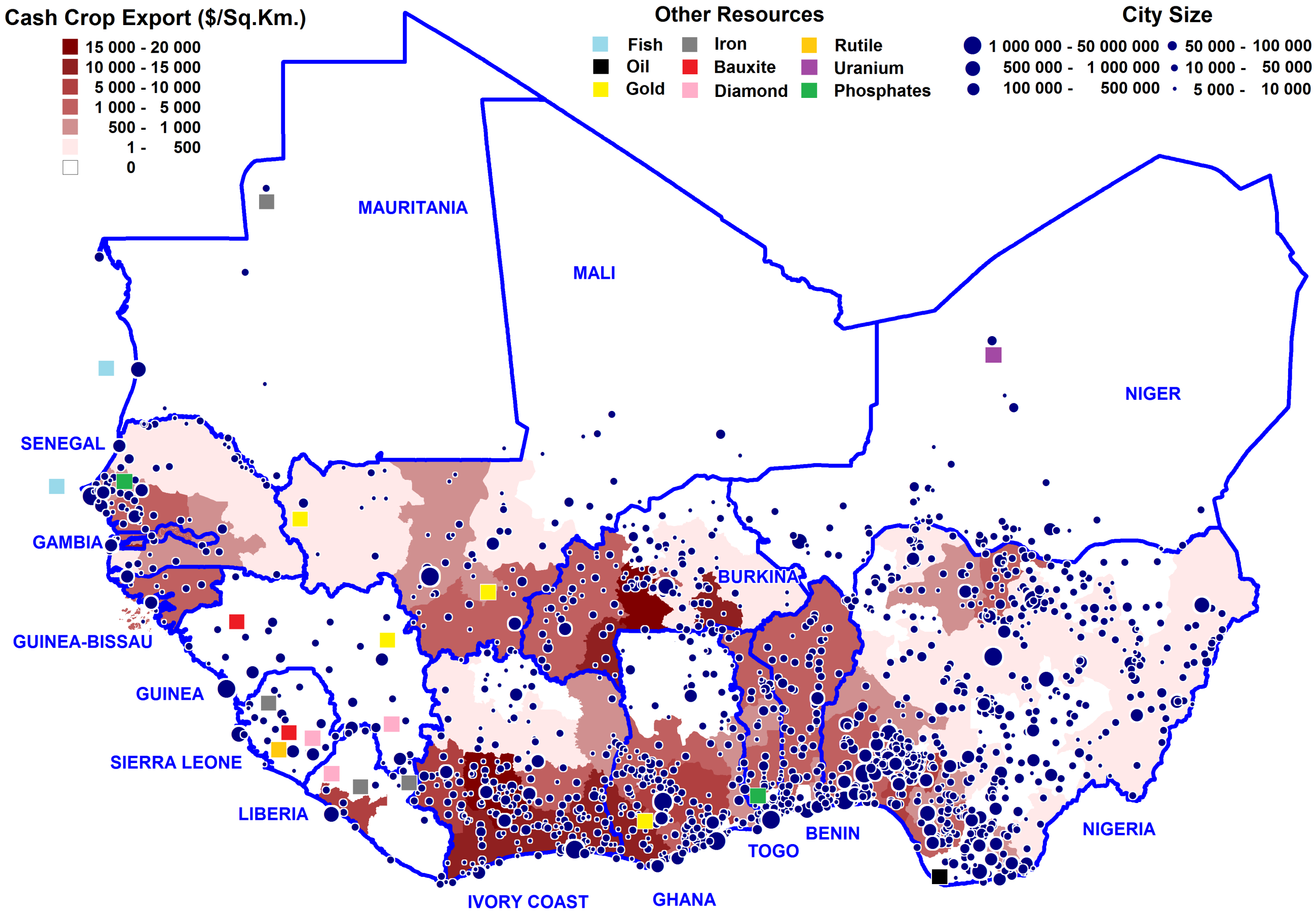
Sources: WUP 2009, WDI 2010, Author's Calculations. America-Asia includes developing countries from Caribbean (4), Central America (8), South America (12), Eastern Asia (2), South and Central Asia (7) and South-Eastern Asia (9). Africa includes countries from Sub-Saharan Africa (39). Small island and enclave countries are intentionally excluded from this analysis.

Figure 2: Primary Exports and Urbanization in Africa in 2000.



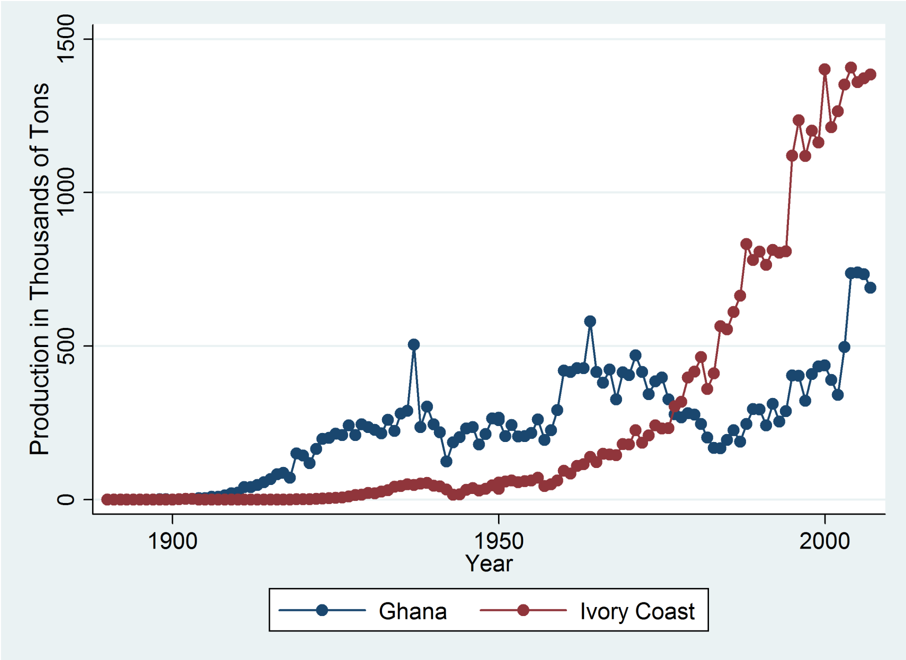
Sources: WUP 2009, WDI 2010, USGS 1960-2000, Author's Calculations. Our sample consists of 39 Sub-Saharan African countries. Primary exports include mining and cash crop exports. Subfigure *a.* uses their contribution (in %) to GDP in 2000, while subfigure *b.* uses their average contribution to GDP (in %) between 1960 and 2000, using a 5-year panel I constructed.

Figure 3: Cities, Cash Crop Exports and Main Oil/Mining Producing Areas around 2000.



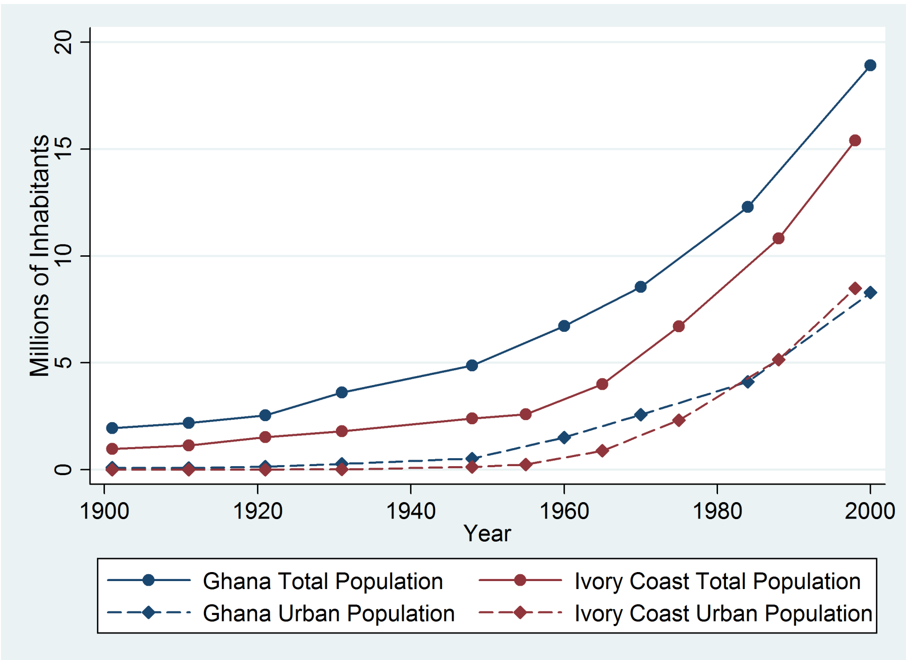
Sources: Geopolis for cities, national statistical institutes for regional cash crop exports and USGS Minerals Yearbooks for oil/mining producing areas. Cash crop and mining data corresponds is from for Liberia and Sierra Leone, as they were affected by civil war in the 1990s.

Figure 4: Cocoa Production (in Thousand Tons), 1890-2007.



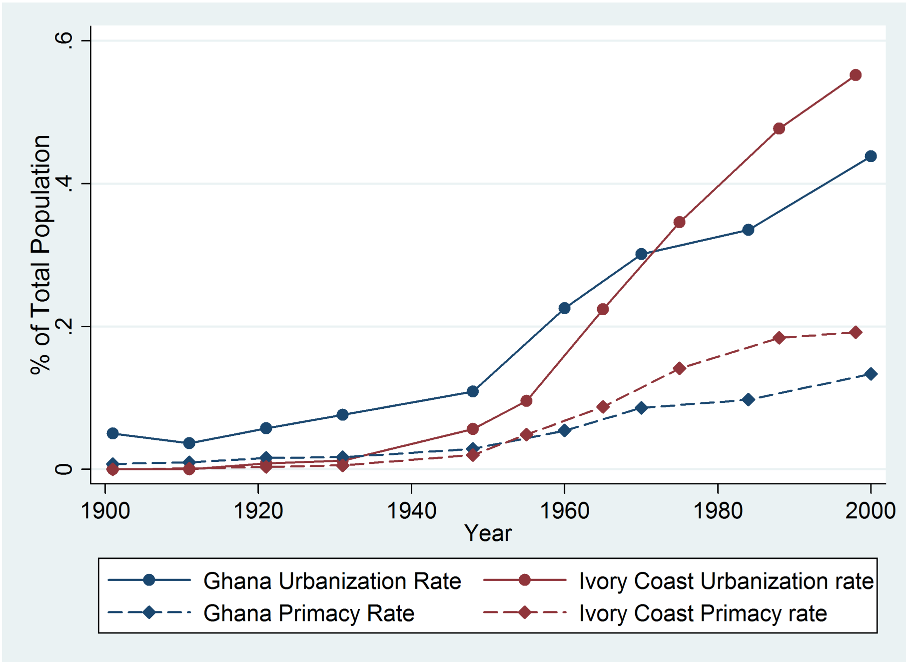
Sources: see data appendix for more details.

Figure 5: Total and Urban Populations, 1900-2000.



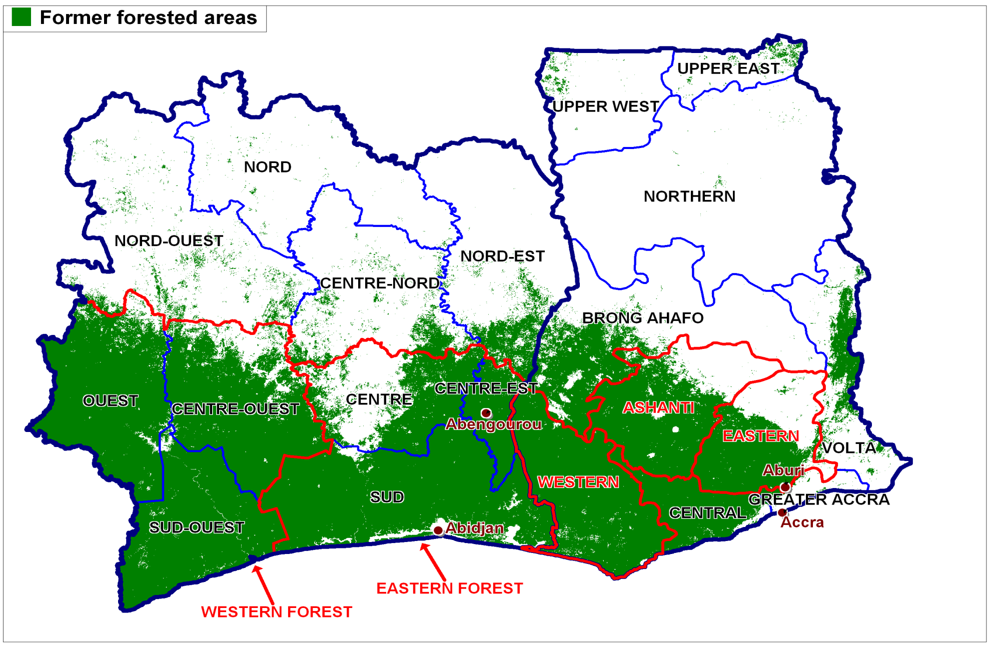
Sources: see data appendix for more details.

Figure 6: Urbanization and Primacy Rates, 1900-2000.



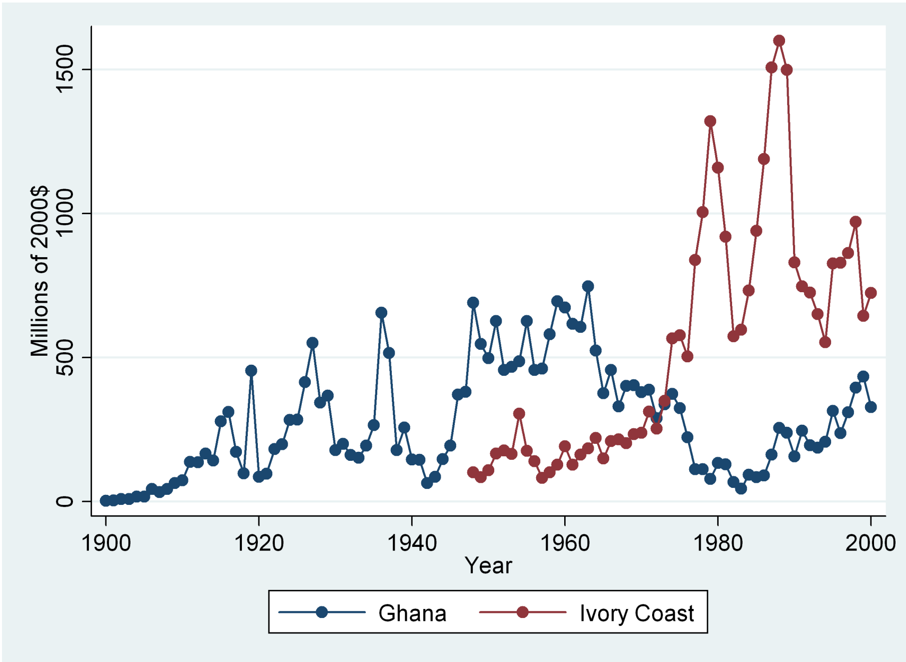
Sources: see data appendix for more details. The urbanization rate is defined as urban population over total population * 100, and the primacy rate is the size of the capital city over total population * 100.

Figure 7: Former Forested Areas, Regions and Historical Starting Points.



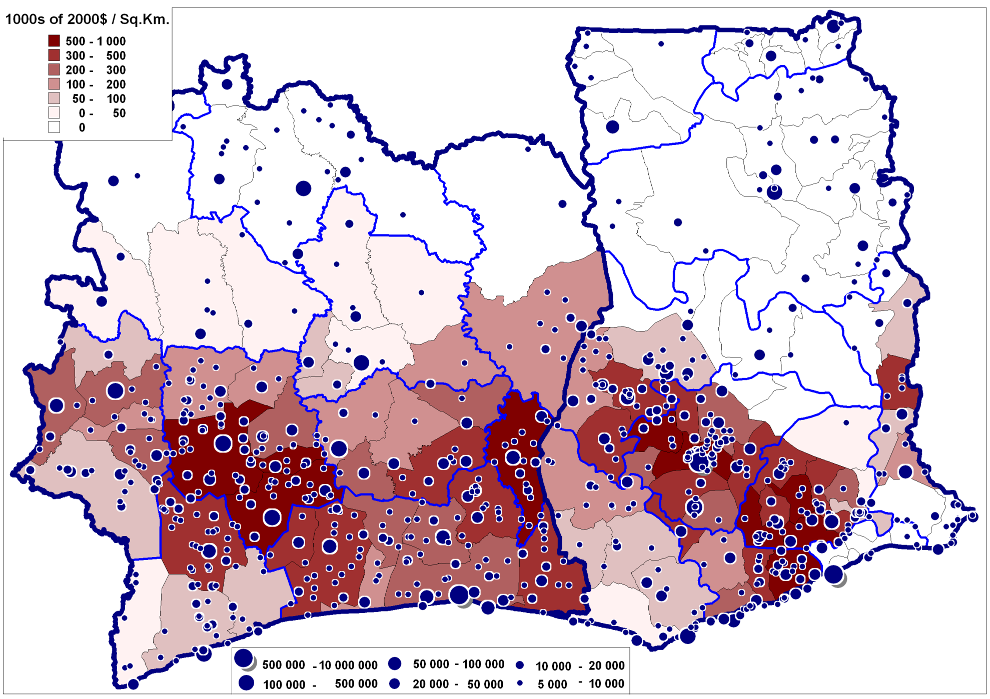
Sources: see data appendix for more details. Former forested areas were virgin forests one century ago, before cocoa production started. Aburi is the historical starting point of Ghanaian cocoa production. Abengourou is the historical starting point of Ivorian cocoa production.

Figure 8: Value of Cocoa Production Going to Cocoa Farmers, 1900-2000.



Sources: see data appendix for more details. The value of cocoa production in year t is calculated as the quantity produced that year (in tons) multiplied by the price per ton (in 2000$) that year.

Figure 9: Value of Cash Crop Production (1900-2000) and Cities (2000).



Note: The value of cash crop production includes the total district value (in thousand 2000$ per sq.km.) of cocoa production in Ghana from 1900 to 2000, and cocoa and coffee production in Ivory Coast from 1948 to 2000 (not much was produced before 1948).

Figure 10: District Density of Cocoa Production and Cities in 1948.

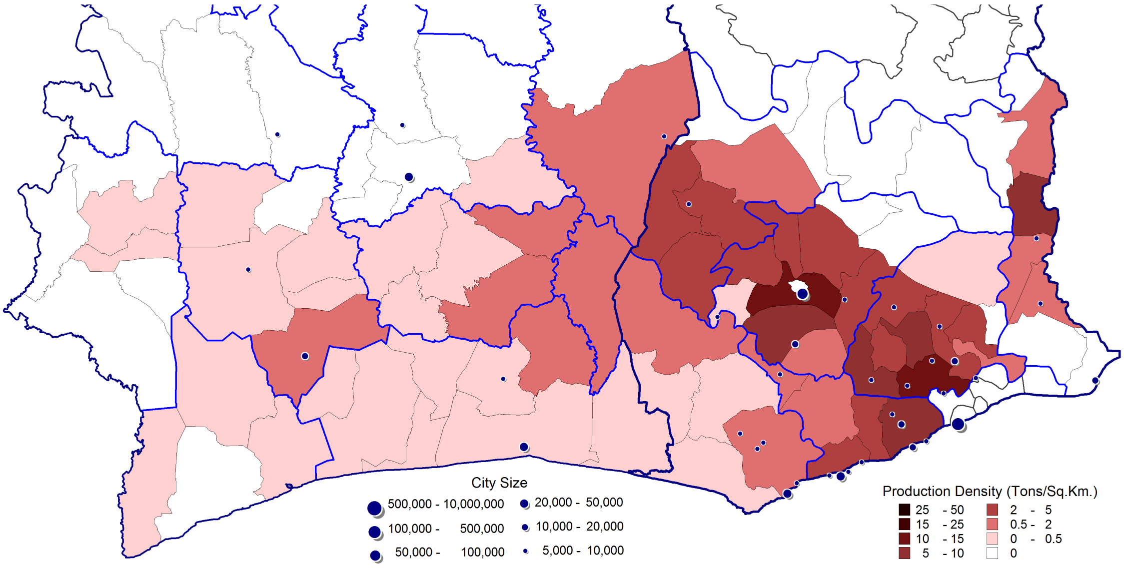
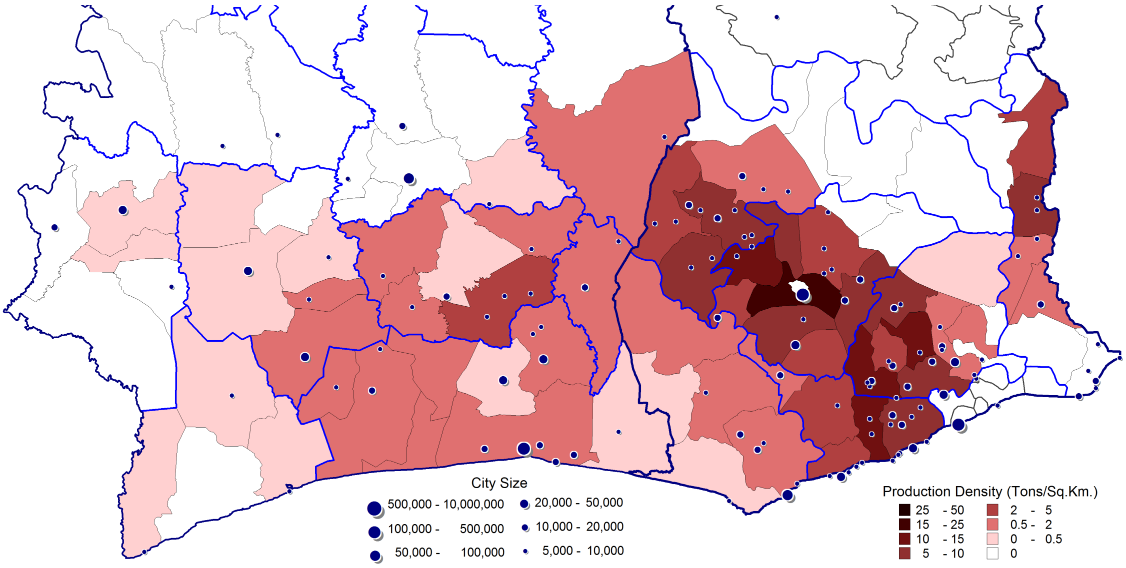
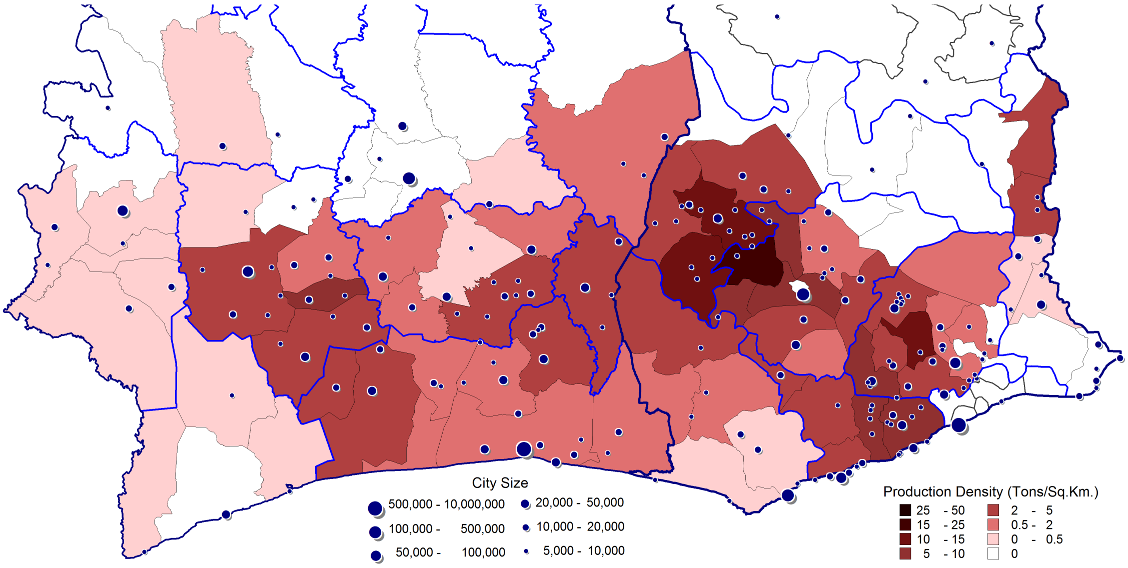


Figure 11: District Density of Cocoa Production and Cities in 1960-1965.



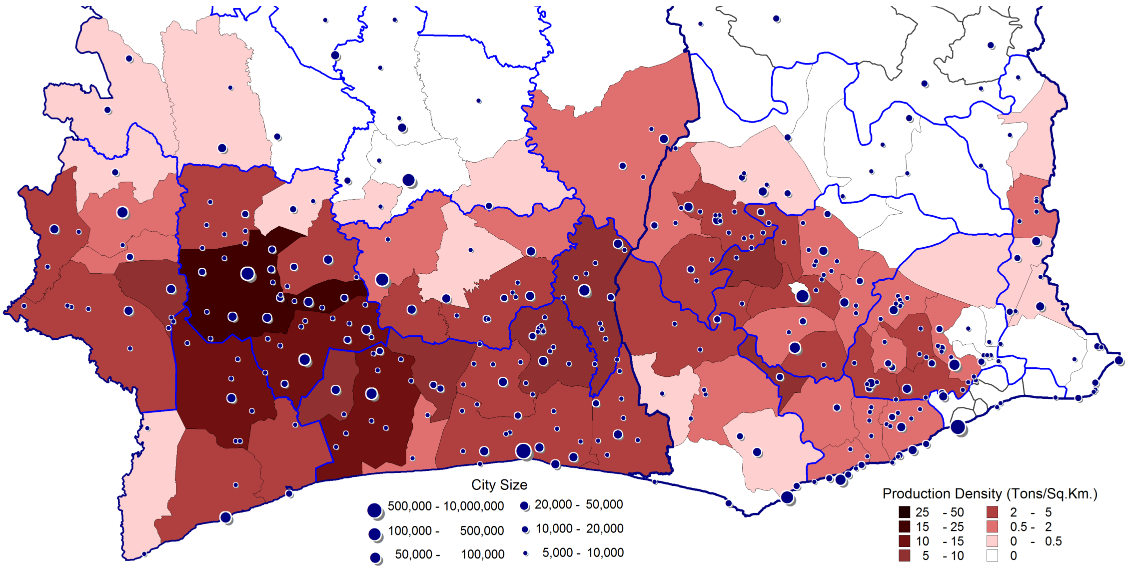
Note: 1960 in Ghana, 1965 in Ivory Coast.

Figure 12: District Density of Cocoa Production and Cities in 1970-1975.



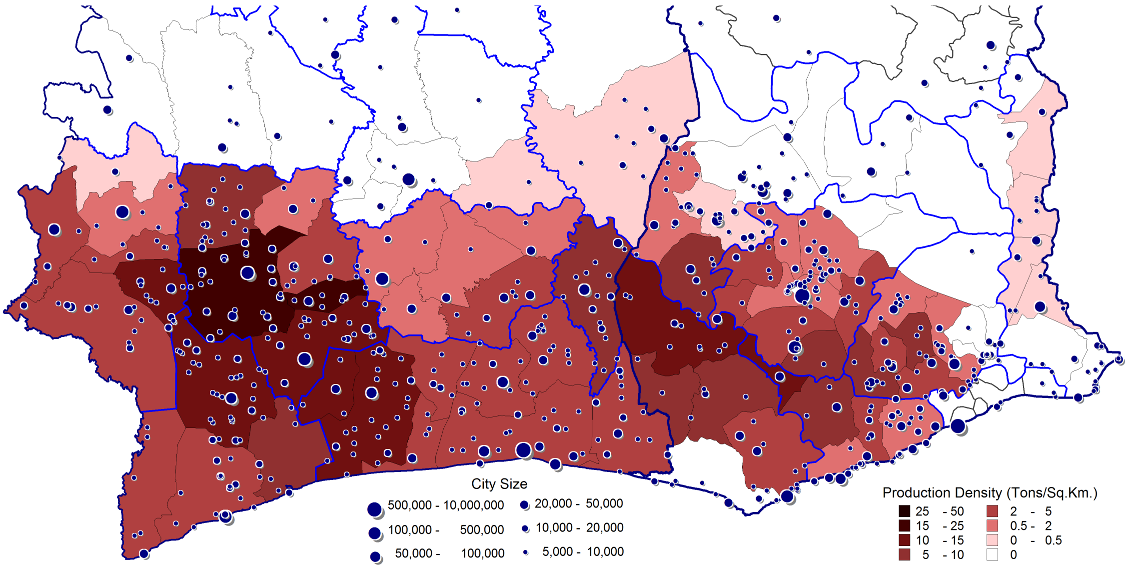
Note: 1970 in Ghana, 1975 in Ivory Coast.

Figure 13: District Density of Cocoa Production and Cities in 1984-1988.



Note: 1984 in Ghana, 1988 in Ivory Coast.

Figure 14: District Density of Cocoa Production and Cities in 1998-2000.



Note: 2000 in Ghana, 1998 in Ivory Coast.

Figure 15: District Density of Cocoa Production and Cities in 2009.

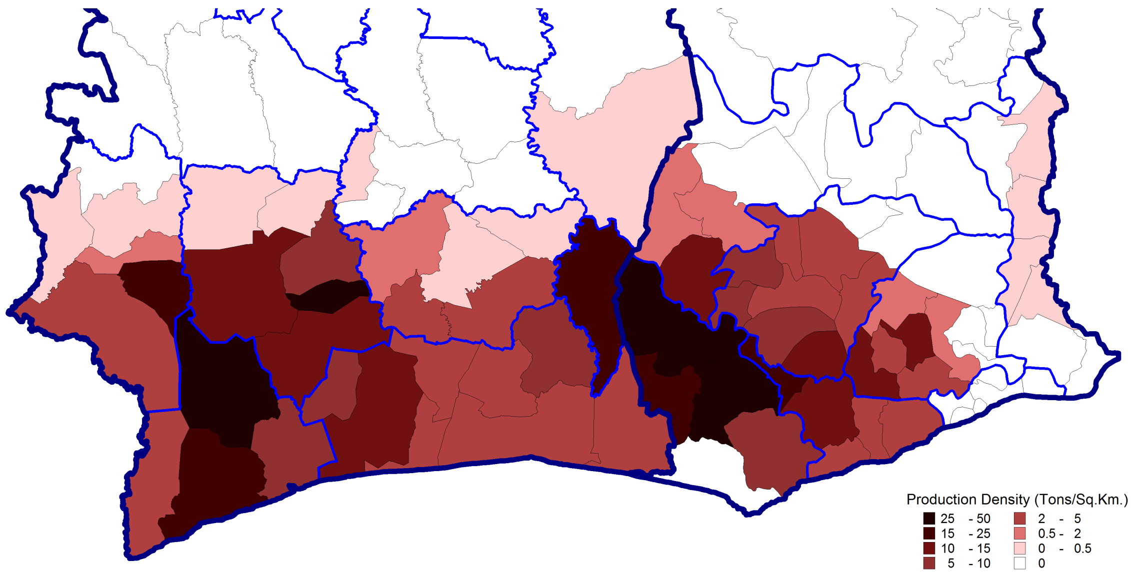
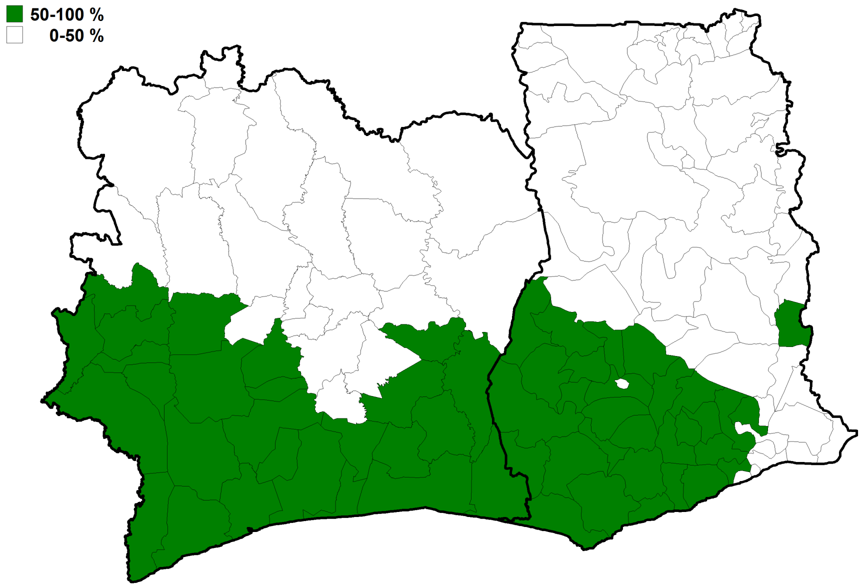


Figure 16: Share of District Area Suitable to Cocoa Production.



Sources: see data appendix for more details.

Figure 17: Centroids and Longitude Bands of One Degree.